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on
January 1 and July 1, that they may be inspected by the Committee.

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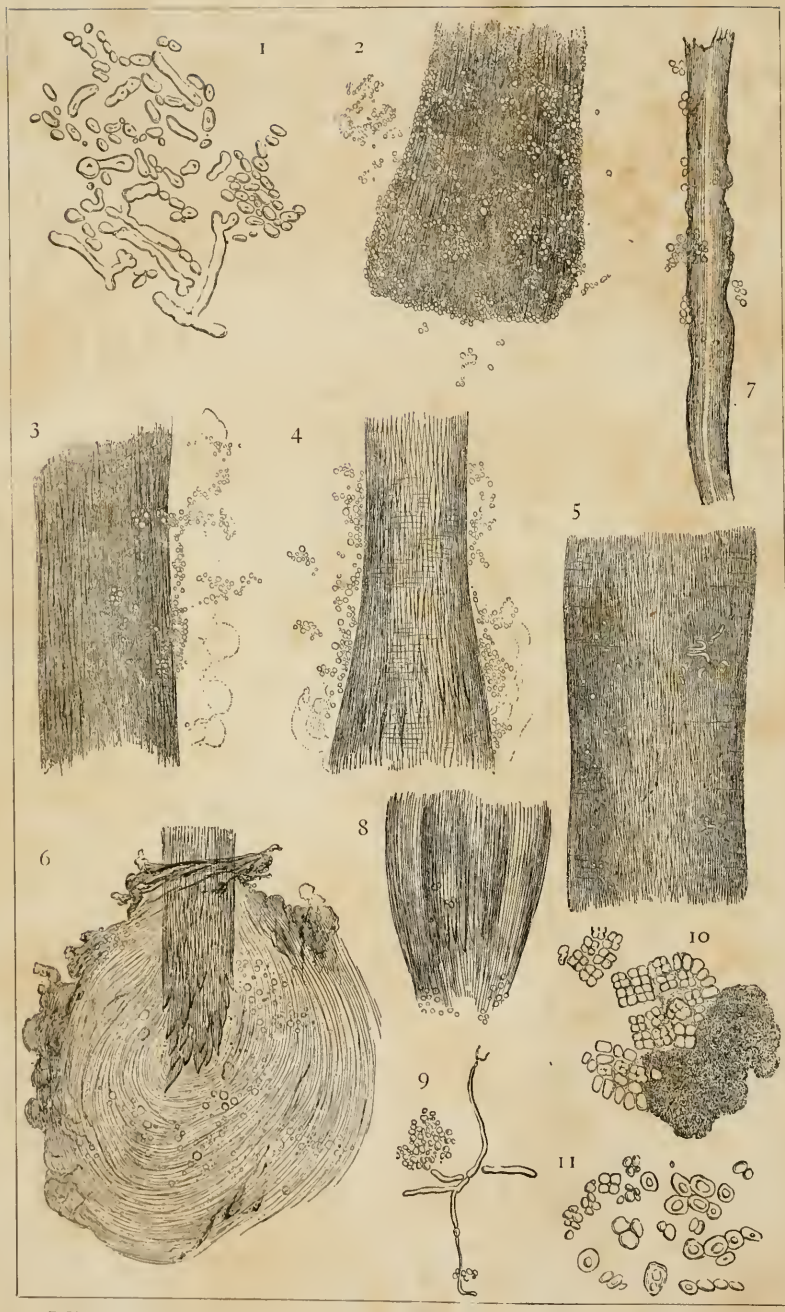
SKIN DISEASES

OF

PARASITIC ORIGIN.

PLATE I



HARVEY ORRIN SMITH

DEL. ET SCULP.

SKIN DISEASES

OF

PARASITIC ORIGIN:

Their Nature and Treatment.

INCLUDING

THE DESCRIPTION AND RELATIONS OF THE FUNGI FOUND IN MAN.

BY

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PREFACE.

It is a matter of frequent confession that diseases of the skin are not only little understood, and receive at our medical schools much less attention than their importance demands, but that their treatment is in great part empirical, and their classification in need of reconstruction. Much of this shortcoming arises from the fact that skin diseases form a *specialty*, and this leads observers not only to estimate them as local ailments, but shuts out of view many co-existent conditions which act as guides to treatment by suggesting a variety of causation. To separate skin diseases from out the domain, and to study them as other than part and parcel of general medicine, is utterly wrong and antagonistic to successful treatment; yet such is the marked error of the present day. Diseases of the skin are but outward evidences, in the vast majority of cases, of certain alterations of the blood, and he who would be a thorough dermatologist, must comprehend intimately, and have under constant observation, the details of medicine generally. Acne, one of the commonest and most annoying diseases of the surface, to which I have paid much attention, is an apt illustration; I believe, in the great bulk of instances, it is related as cause and effect with *definite* and remediable derangements of the *stomach* and *uterine* functions, mostly, indeed almost invariably disregarded.

The ordinary treatment by arsenic or iron is empirical, and takes no cognizance of those deviations which compose the cause. In turning my attention to skin diseases I have most sedulously avoided the error noticed.

I submit to the profession this work, which treats of vegetable parasites and the diseases with which they are associated (popularly known as ringworms), as one of a series of essays on skin diseases; and inasmuch as there is no English collective account or text-book of the kind, embracing not only the nature and treatment of tinea, but also a descriptive account of epiphytes and entophytes, and the relations which these bear severally to each other, an attempt is made to supply a want which, pretty generally felt in the schools, is a serious impediment to the study of this branch of skin diseases.

At the present time authorities are divided by two opposite views: the one that fungi play no special part in diseases, but are *accidental* products—the other that fungi are *essentially* the cause of all abnormal conditions found in connexion with their growth. These opinions are, it appears to me, neither of them exact, and the error arises from the confusion of *eruptive* and *parasitic* diseases; for, as I shall endeavour to show, the lesion of the hairs (and epithelium) is that which is *peculiarly* produced by a parasite, and by it alone.

The nature of parasitic diseases will be considered in the first place, and subsequently the question of the identity of the fungi found upon or within the human body. I claim for my facts the character of trustworthiness, since everything has been rejected which repeated observation has not in my mind satisfactorily shown to be truth. In some instances, *ex.*, under the head of torula, and sarcina, a fuller amount of detail might have been given, but it seemed to me preferable to treat the subject in a manner useful to the medical

practitioner rather than in a truly botanical sense ; however, if need be, the deficiency can be supplied.

The minute descriptions of the parasites are in reality pretty much condensations from those of Küchenmeister; in the instance of Chionyphe Carteri (fungus foot of India), from Dr. Carter and Rev. Mr. Berkeley ; to the latter gentleman my thanks are due for his kindness in forwarding me the original drawing of Dr. Carter for the purpose of illustration.

The plates given represent objects magnified with a power of from 200 to 400 diameters. In part they are wood engravings, and in part produced by the recent process, *kerography*, and have been executed for me by Mr. Harvey Orrin Smith, by whom most of the original drawings were made. Kerography, which is well illustrated by the contents of Plate I., and has been little, if at all used in medical works, represents most faithfully microscopic appearances, and is singularly applicable where wood-engraving fails. Many artists omit, from some cause, to portray accurately the relative size of structures and attacking fungi ; I believe that with one exception all my figures are especially correct in this respect.

W. T. F.

15, Old Cavendish-street,
Cavendish-square, W.
October, 1863.

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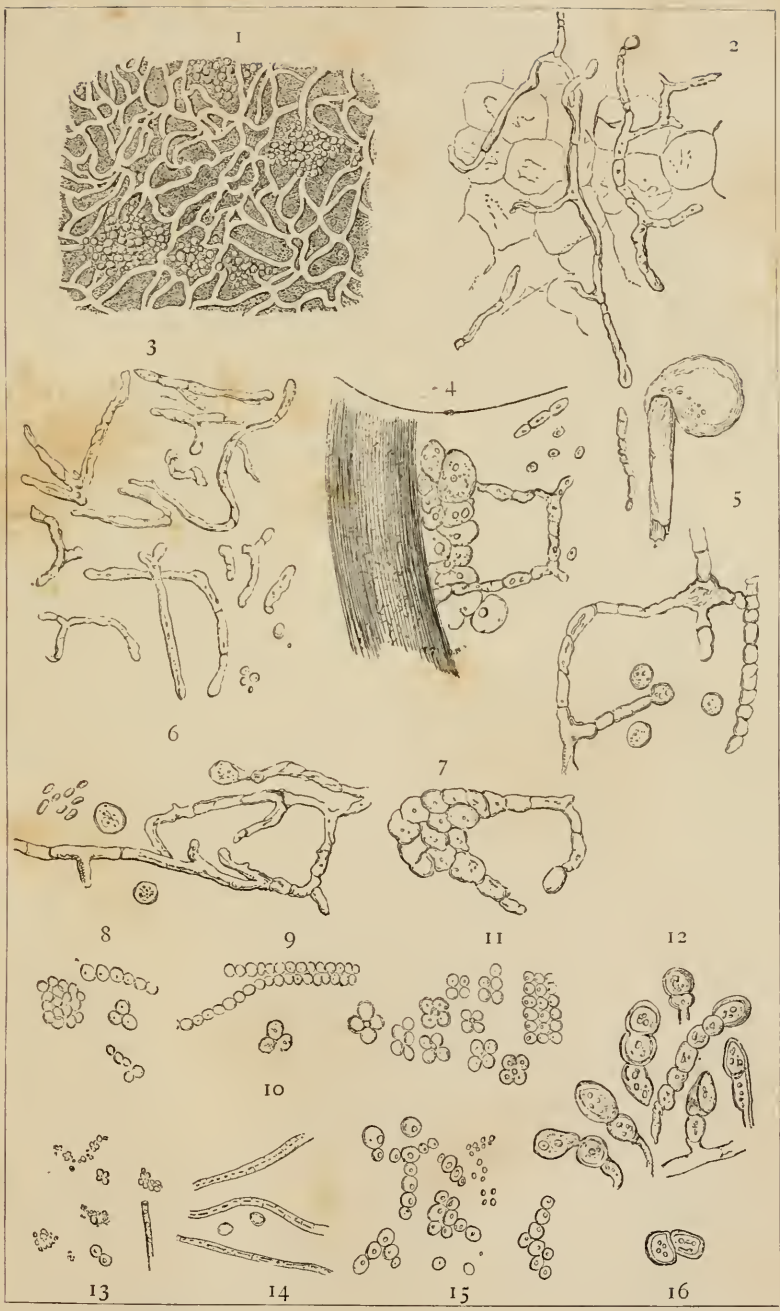

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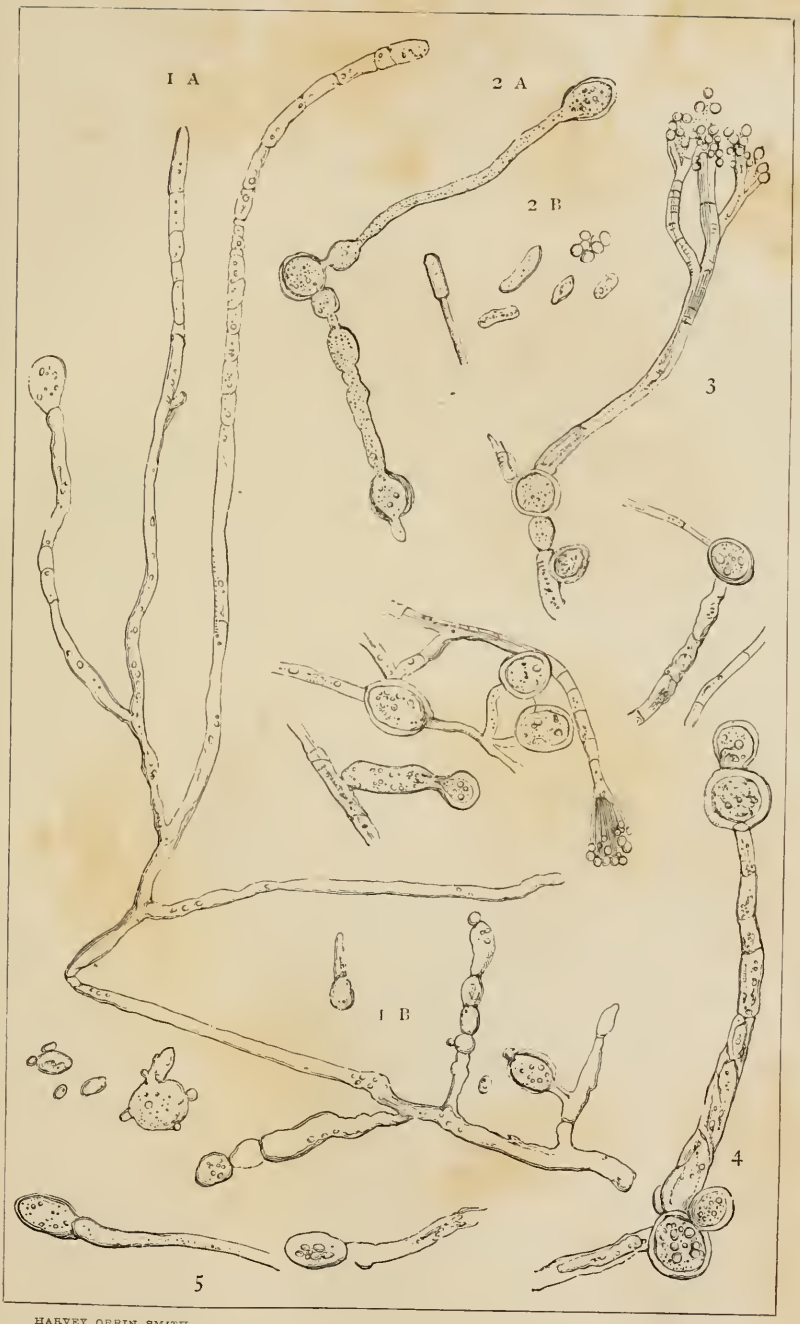
PLATE III.



HARVEY ORRIN SMITH, DEL. ET SCULP.

PLATE IV.

AFTER REV. M. J. BERKELEY.

HARVEY ORRIN SMITH. DEL, ET SCULP.

PART I.

THE NATURE

OF

PARASITIC DISEASES OF THE SKIN.

CHAPTER I.

Description of Parasitic Diseases.

In studying the subject of parasitic diseases, one great desirability is felt—viz., the simplification of the present nomenclature, for endless confusion arises from the use of such terms as scall-head, ringworm, porrigo, and the like, since they, having lost their original meaning, have come to signify very dissimilar diseases, and in the progress of pathology have been loosely applied by different observers. The diseases of the surface necessarily connected with the growth of fungi may be classed under the generic term *Tinea*, and those appellations now in use which notify the several varieties, retained in great measure, as follows:—

1. Tinea favosa.
2. Tinea tonsurans.
3. Tinea circinata (Herpes circinatus).
4. Tinea sycosis (vel menti).
5. Tinea decalvans.
6. Tinea versicolor (chloasma).
7. Tinea polonica.
8. Tinea pilaris (a complication of "chronic skin diseases").
9. Tinea tarsi.

The above arrangement will be acceptable not only to

students, but the profession generally; it mystifies nothing, and certainly removes much that interferes with the prosecution of the study of parasitic diseases. It would be well, moreover, to prefix the word parasitic to those instances of the more usual forms of skin eruption which are complicated by the growth of fungi; for example, parasitic herpes, parasitic lichen, parasitic psoriasis, and so on. Adopting the terms suggested, I proceed at once to give a condensed account of the characters of the tineæ as generally taught, omitting novel points for after discussion.

Tinea Favosa.

Syn.:—Favus—Teigne—Porrigo lupinosa (Willan), the favus dispersus of Wilson—Porrigo scutulata seu tinea annularis of Biett and Rayer—Tinea rugosa—Scall-head—Honeycomb scall.

General Seat: Usually the head, but it may occur upon the trunk or extremities. *Primary Seat:* Hair follicles.

External Characters.—The disease is characterized by the presence of straw-coloured cupped crusts (favi), surrounded by more or less redness; these coalesce, and pour out a viscid fluid, which "concretes" into apparent scabs, the whole presenting a somewhat "honeycomb" appearance.

Mode of Origin and Progress.—At the outset there is, as detailed by Simon, simply an increased formation and accumulation of epithelial scales at the very point where the favus is about to form, then a circular white speck is seen beneath the raised epidermis at the hair follicle, the fungus having found its way to the under surface of the epithelium, which becomes detached in part from the subjacent corium, and if an examination is now made, the spores will be easily detected, with more or less granular (molecular) matter. Increased formation of epithelium follows, accompanied with more or less "irritation" as the parasite finds its way downwards into the follicle; the favi then become developed, their colour becomes sulphur-yellow, they are each pierced through their centre by one or more hairs, which presently loosen

and easily come out, at the same time becoming thickened, opaque, non-elastic. The favi may be oval, and the hairs may come through, not at the centre, but near the extremities of the oval; in this instance, the crust is thicker in the larger part of the cup as divided by the hair. Each cup is seated upon a depression of the derma, and composed almost entirely of fungus, and, as it were, of two layers; the one next the epidermis made up of amorphous particles, and known as the *stroma;* the other, which is a more developed condition of the former, is that usually regarded as the achorion, and consists of spores and tubes. The fungus in its descent into the follicle destroys the hair-sheath, and, finally, the formative papilla, in the meantime finding its way up into the shaft of the hair. The so-called scabs increase by augmentation of their circumference, and coalesce more or less, forming a continuous irregular mass, in which the primitive favi may mostly be recognised, and according to fluctuations in this respect varieties have been defined, but there is no constancy exhibited in regard to this point. As the disease progresses the mass dries, and hence becomes lighter in colour, more brittle and cracked, and the aspect thus presented may be permanented for some time. Loss of hair now shows itself, and the crusts when removed leave the scalp tumid, tender, ulcerated, and scarred. The lymphatics and glands may be inflamed, and the patient become cachectic. If one of the old scabs be examined, it will be found to consist of (*a*) an external part (forming the free edge), which is yellow, thick, and composed of fungus in an advanced stage of development, viz., sphorangia and filaments; and (*b*), an inner portion next the skin, composed of the thallus. Mixed up with the fungus, there may be epithelium, pieces of hair, fatty matter, pus, even pediculi and ova, and, as some assert, puccinia. If the cups be cleared from the scalp by poulticing, and a clean surface obtained, the old condition is reproduced, crops of little yellow dots appear here and there, and quickly change to favi. Permanent baldness is not unfrequent. The nails may become diseased, and are then thickened, made opaque, and quasi-fibrous, and

the fungus may find its way through them to the surface. The secreting glands of the part attacked suffer material damage, and hence the dry, dull appearance of the hair is in some measure due to the loss of sebaceous matter. Favus, which is a contagious disease, and often accompanied by more or less pyrexia, is usually seen in scrofulous subjects, and implanted upon pre-existing eruption. Residence in low, damp places, with coincident mal-hygienic conditions, predispose to its occurrence. The odour emanating from favus patients is variously described as that of mice, cat's urine, and the like. The diagnosis offers no difficulty. The fungus is the Achorion Schönleinii.

Tinea Tonsurans.

Syn.:—Porrigo scutulata of Willan and Bateman—Herpes tondens of Cazenave—Trichoses furfuracea of Wilson, according to whom identical also with Porrigo scutulata —Rhizo-phyto-alopecia (Gruby).

Seat: Scalp; said not to occur in adult life,—this is an error, however. Consists of circular patches, where the hairs look dry, withered, crooked, and at length broken off as if nibbled. The hairs are thickened, opaque, at first pale, then lose their elasticity, and break off about two or three lines distance from the follicle; prior to this, however, they are bent or twisted at the place of fracture, which is found to be infiltrated by the fungus. The patches vary in size from that of a threepenny-piece to that of the palm of one's hand, and the hairs come out readily enough. The surface of the patch is covered over with "micaceous" scales, and an appearance of "fringing" around the orifice of the hair follicle is produced, that is almost characteristic of the disease, and is best seen when the scales over the general surface of the patch are not very numerous. The scales are chiefly the remnants of vesicles, of which traces may be obtained at the free edge of the diseased spot (the sporules invade the scales in question), and vesicles are distinctly recognised in the early stage of many cases, or in the fresh patches which spring up

from time to time. Sometimes a ring of redness circumscribes the patch, and increases centrifugally, pari passu with the disease. The fungus finds its way into the follicle, causing increased production of epithelium which is more or less ill-developed and diseased. The papilla and root-sheath suffer in turn, and presently atrophy of the hair bulb is noticed. The hairs are split up, loaded with sporules and thicker in consequence, and this thickening may assume a regular or irregular form according to the manner in which the fungus is distributed throughout the shaft. If you attempt to epilate, the hairs being brittle, break away, and in part are left behind. Around the edge of the patch the hair is thinning out oftentimes and frequently diseased. Several patches may unite. The disease is contagious. Itching is often a troublesome symptom. Eruptive manifestations may be evoked by the irritation consequent upon the growth of the fungus. Alopecia may result, and is generally temporary, but permanent in severe cases if left untreated. Bazin describes a stage in which pus occurs, probably "with the object of including sycosis under the same head." It is frequently conjoined with Tinea circinata, and many authorities hold that the latter in travelling from the parts near to the scalp assumes the characters of the former. The fungus is the Trichophyton tonsurans (Malmsten). *Syn.:* Trichomyces tonsurans—Mycoderma of Plica Polonica (Günsberg) — Achorion Lebertii — Rhizo-phyte (Gruby).

Tinea Circinata (*Herpes circinatus*).

The patient usually comes for advice when the disease has lasted for some little time, and it appears then as though vesicles had formed and dried up. They are very small, grouped in a circular manner on a red base of from two to four lines to, rarely, two or three inches; the breadth of the actual ring varies from one to five or six lines. The vesicles when seen contain at the outset a transparent fluid, which presently assumes a milky aspect. The patch now takes on a dry and scaly appearance; its central part, losing its original blush,

becomes the seat of "furfuraceous desquamation." There is a continuous centrifugal springing up of fresh vesicles at the circumference of the patches. The usual seats of the disease are the face, neck, breast, and upper limbs (more especially the right). The active stage of any one spot is run in ten days or so, but successive patches mostly make their appearance here and there, often for a considerable time. In the slighter forms (for there are various grades of this variety of tinea), simple furfuraceous desquamation is observed. The disease is, as the rule, preceded by slight irritation and evanescent erythema. It is decidedly contagious. It differs from all other forms of herpes in the fact that the vesicles are never but indistinctly developed, and also in its being a purely local disease. Its slightest forms suggest its identity with erythema circinatum. It has been observed to interchange itself with tinea tonsurans and even sycosis; it may become the seat of favus, and occurs at any age, but chiefly in young people. It frequently co-exists with tinea tonsurans in the same subject, and may be apparently epidemic in schools and the like. The fungus, which may be readily detected, is the Trichophyton tonsurans.

Tinea Sycosis.

Syn.:—Mentagra—Darte pustuleuse—Chin-welk Mentagrophyte—Sycosis menti.

This is a disease of adult life, characterized in its origin by heat, itching, tension, and redness of the part affected, followed by the appearance of bright red spots or vesicles, which soon become pustular, hard, and acuminated, exuding a yellowish liquid drying into crusts. The little indurated swellings may be in reality "under the skin," and easily felt (they are said to be pustular in this condition). As matters progress, the pustules become very hard at their bases, the tissues around swell and become very tense, both subjectively and objectively; shaving is very painful, and the hairs get matted together. Successive crops of pustules are developed, the hair follicle becomes still more inflamed and its coats

thickened, and pus may even be present. Remissions are common after spring and autumn. The disease generally affects the chin, but may be seated in any part of the whiskers, moustache, or beard, rarely inside the nostril, and still more rarely in the region of the eyebrows and pubis. The disease, as rightly considered by the ancients, is contagious. All classes of the community are equally liable to be attacked. If any exhibit special proclivity, it is such as are engaged in occupations which necessitate exposure to great heat—*ex.*, smiths, founders, and engine-men, and of these especially those who are given to drink. The disease, not infrequently preceded by minor eruptions, is liable to be confounded with acne, ecthyma, syphilitic impetigo, &c. The fungus, which is said to form a sheath, as it were, around the hair shaft, is the Microsporon mentagrophytes.

Tinea Decalvans.

Syn.:—Porrigo decalvans of Willan — Teigne achromateuse of Bazin — Alopecia — Area — Ophiasis—Tinea tondens of Mahon—Phyto-alopecia of Gruby:

Is characterized by the presence of circular, pale, smooth spots, from which the hair has fallen without previous change (?). The denuded patch is left simply smooth and bald, the follicles are distinctly visible, the hair, on examination, is seen to be bulbless and dull, and at an early date a fungus is detected invading it and the epithelial scales. The disease is very often preceded by erythema of the scalp, or by "scurfiness," in the scales of which the fungus is often to be found. The hair of the head in general is oftentimes peculiarly dry and withered, as though the scalp lacked moisture. The first appearance of the disease is visible at some part of the side of the head, differing in this respect from senile alopecia. The entire scalp may be affected, the eyebrows, and very rarely the chin and pubis. Tinea decalvans is said to be essentially a disease of young life; it is questionable, however, if it be so *relatively* speaking. The alopecia is said to be acutely produced. There is great proba-

bility that the fungus is often overlooked, often left behind in the follicle, when an examination is made, in consequence of the absence of adherent epithelium, often discoverable upon the shaft some distance from the follicle, or in the epithelium,—that the fungus often dies out in the later stages of the affection, and that the granular condition of the parasite is disregarded as evidence of its presence. The scalp is not generally congested, but some slight irritation and puffiness may accompany the disease. It is contagious. Wagner found the epidermis, rete mucosum, corium, and hair follicles normal in a case of alopecia. The plant is the Microsporon audouini.

Tinea Versicolor.

Syn.:—Chloasma—Pityriasis versicolor—Pityriasis lutea:

Consists of patches of irregular shape, of a fawn colour, scarcely elevated above the level of the surrounding skin, occurring chiefly on the chest, especially the parts covered by flannel, accompanied, or rather preceded, by local irritation in the form of little bright rings, which coalesce, and produce irregularly shaped patches, which fade in colour, desquamate, feel rough to the finger, and are scaly at their edges. The seat of the fungus growth is sub-epidermal. The patches are well defined, oftentimes not only is the epithelium, but also the hairs of the part affected, attacked, but owing to the minuteness of the latter, this feature is not well marked. The disease is said to be common in phthisical subjects, often dies out of its own accord, is a sign rather of want of cleanliness, and is decidedly contagious. According to Mr. Hunt, there are two varieties—the one contagious and local, the other non-contagious and constitutional; the former is the least common form, and is distinguished from the latter (the non-contagious pityriasis lutea, or true chloasma, as Mr. Hunt styles it) by "the borders of the patches being indistinctly shaded off, and by their more irregularly diffused form." The term pityriasis versicolor, or rather tinea versicolor, should be limited to the contagious variety. There can be no doubt that pigmentary changes in the rete

mucosum produce appearances which have been inaptly classed with the disease under notice, for example, vitiligo, ephelis, maculæ hepaticæ, &c. Children are not very frequently attacked. The plant is the Microsporon furfurans.

Tinea Polonica.

Syn.:—Plica polonica—Trichoma—Plicatio.

It is endemic in Russia, Poland, and Livonia, and very little understood in this country. One derives, from reading, the impression that the disease is an inflammation of the piliferous bulbs, accompanied by an increased development and a matting together of the hair of the parts affected. Constitutional symptoms are said to mark the onset of severe forms of plica. The scalp then becomes red, tender, tumid, and bleeds upon the slightest provocation; it effuses a reddish glutinous matter (in conjunction with inflammatory products), which, matting together the hairs, dries into a horny mass. The hairs themselves appear swollen and infiltrated by the same fluid, and if an attempt is made to epilate, great pain is felt. Blood, fungus elements, and pediculi are mixed up with the mass, and the structures are said to be invaded by the parasite. The varying manner in which the matting takes place has led many to describe several species. When the hair is felted together into one uniform mass, the disease has been called (by Alibert) *plique en masse*. *Plique multiforme*, signifies the existence of several distinct locks; and when the hair grows to a considerable length, and somewhat similar to the tail of a horse, the disease is called *plique en queue*. Plica affects the face, axillæ, pubis, as well as the scalp. The nails are generally diseased, and (their matrices being destroyed) often shed. By-and-bye an improvement takes place; the diseased mass is "pushed off," as it is termed. All classes are liable to be attacked, but more especially those resident in marshy districts. According to some, the occurrence of plica is attributed entirely to want of cleanliness. It has been supposed to be due, in some degree, to the practice of keeping the head closely shaven,

but this is not confined to those districts in which the disease is endemic. It would appear, however, from many considerations, that a want of cleanliness has much to do with its ætiology. The fungus is the trichophyton sporuloides. Simon notices the presence of a fine granular amorphous substance accompanying the latter.

The following appears in the *Pract. Journ. of Med. and Surg.* for April, 1859, p. 176:

"Article 5631. Academy of Medicine. Dr. Raciborski read a paper entitled: '*Remarks on Plica Polonica, and on a new form of Hypochondriasis which might be called Trichomatic Hypochondriasis.*' According to the opinion most prevalent in Poland (said the author), plica consists in a sort of crisis, the most favourable termination of a special diathesis, which may occasion serious disturbance of health, and dependent sometimes upon rheumatic tendencies, and occasionally upon neuralgia, or some form of neurosis or inflammation. Whenever the presence of this diathesis is suspected it is proper to endeavour to promote the matting of the hair. Woe to him who, on the detection of the first symptoms, should imprudently attempt to unravel the entangled locks, or cut them before the time when the crisis has reached its maturity. He would promptly be assailed by a host of evils, the cause of which nature was preparing to eliminate. This doctrine, of popular origin, has long been entertained by the majority of Polish physicians, and by their neighbours the Germans, as much from conviction as from a desire to cloak either their want of knowledge to discriminate or of power to remedy various chronic diseases, which they are not sorry to be able to refer to an undetected or improperly treated trichomatous diathesis—a plausible explanation of the obstinacy of the cases. Other physicians deny the existence of a peculiar trichomatous diathesis, but persist in considering plica in the light of a manifestation of a critical nature, encouraged by certain endemic influences, and liable to appear during the course of various complaints. Others finally attribute plica merely to superstition and uncleanly habits; the disease, in their

opinion, is undeserving of the attention of physicians, and they think, with Desgenettes, that its treatment should be abandoned to hairdressers. It is a fact admitted by all those who have written on the subject, that the matting of the hair may be brought on by mere inattention to common cleanliness. This neglect is sometimes found among persons belonging to the highest classes of society, from the erroneous impression that trichosis is but the appearance of a favourable crisis, which augurs well for the future health of the patients. M. Raciborski then exhibited an enormous plexus of hair which had been removed from the head of a Polish clergyman, and formed the external part only of the entangled mass. The patient had applied himself for seven years to the production of the present result, promoting in every imaginable way the matting, and in order to secure this object, he had even poured upon his hair a certain amount of melted wax. He was under the impression that by this course he was assisting the operation of nature, and the expulsion of the trichomatous virus. M. Raciborski ascertained, from careful examination of the case, that the patient was affected with genuine hypochondriasis, and that, under the influence of this form of mental derangement, he fancied himself a prey to a multitude of morbid poisons, from which the crisis of plica was calculated to deliver him. The author then entered upon an elaborate study of the different forms of hypochondria, and endeavoured to prove the existence of what he called the *trichomatic* variety, which would be marked by the tendency of the patients to believe themselves affected with the diathesis special to plica. M. Raciborski concluded his paper by an account of the microscopical researches of M. Robin on the peculiar condition of the hair of persons suffering from trichosis. It contains epithelial cells, and a large number of fungi analogous to those of favus (achorion Schönleinii). The tangled mass also presents a powder formed of irregular brownish granules, which are easily separated and consist, 1, of numerous epithelial cells imbedded in a large quantity of fatty matter; 2, of a multitude of fungi similar to those found in yeast; and

3, some few cylindrical filaments, soluble, like fatty matter, in chloroform, and possessed of the same yellowish hue and refracting power. The hair itself seems to have undergone no change." So far as one can gather, no evidence is adduced in support of the existence of the special diathesis, and it is certainly very indefinite to state that the latter depends upon a rheumatic tendency, *or* upon neuralgia, *or* a neurosis, *or* inflammation. Too much stress appears, moreover, to be laid upon the matting together of the hair, for this is not characteristic altogether of plica, more marked indeed in it, because encouraged by the habits of those attacked. There appears also to be no very just ground for admitting into our classification a trichomatous hypochondria, for we might multiply varieties in endless number if we were to be guided by the particular association present in each case.

"Plica Polonica was brought to Pakutia fifty years before Poland, by the people who fled from the Mongolian Tartars, and were called Koltun. The disease did not at first appear along the Vistula, nor did it follow its watercourse, but is reported to have followed the Pruth, Dneiper, Niemen, and as a general rule more along mountain ridges than courses of rivers. The disease is stated to have been known to the ancients, and the heads of Gorgon and of Medusa are said to have been mere mythical representations of this form of disease. The Cimbrians were described by the Romans as people with similar Medusa heads. It is recorded to have prevailed in the Alps, on the Weser, long before it showed itself in Poland, and moreover in Moravia, Hungary, Carniola, Ceylon, Paris, England, America, India; hence Plica Polonica is a bad name. Von Studzienski found it on a pair of turtle doves."—(Küchenmeister.)

Tinea Tarsi.

Syn.:—Ophthalmia tarsi—Psorophthalmia.

There can be no questioning the fact, that in some instances of this disease a fungus may be present, and keep up the inflammatory state of the component structures of the

eyelids. The aspect of the disease is modified on account of the presence of sebaceous glands, which, in addition to the hair follicles, are inflamed (as in sycosis), and pour out a viscid fluid, which encrusts and dries during sleep, sticking the edges of the lids together. This secretion irritates the neighbouring parts, and the edges of the lids ulcerate. The disease occurs mostly in persons of scrofulous habit, and follows frequently in the wake of measles: it may justly be termed tinea pilaris in chronic cases, where the orifices of the follicles are often distinct, and stand out from the general area, as so many distinct focuses of mischief. Alopecia (partial or complete) may be produced. I have seen the coexistence in the same subject of tinea decalvans, tinea sycosis, and tinea tarsi. The fungus, which is the trichophyton, is represented in Plate I. Fig. 9. Mr. Hogg has found puccinia in this disease.

Madura Foot.

In the Transactions of the Medical and Physical Society of Bombay for 1860, is a description, by Dr. H. V. Carter, of a disease occurring in many parts of India, called variously "Ulcus grave," "Morbus tuberculosis pedis," "Madura foot," "Podelkoma," "Mycetoma," and which appears to be due, in some measure, to the presence of a vegetable parasite. It is generally confined to the foot, which is swollen, and exhibits here and there little enlargements, about the size of peas, soft, and provided with an aperture each, exuding a watery, pustular, or dirty fluid, and containing little white masses similar to others met with in the substance of the soft parts, which are composed of "numerous minute tubercles resembling fish-roe, lying beneath the muscles, and extending from the bones to beneath the skin, and nodules composed of the same, often black in colour." These little black grains often surround the openings on the exterior of the foot. Dr. Carter sums up the appearances seen on dissection as follows:—"General confusion of parts, owing to absorption of the bones and fibrous thickening of the soft parts; often the presence of granules, separate or aggre-

gated in mulberry-like masses of a yellow or brown colour, lodged in spherical cavities excavated in the bone, or in the soft parts, or in tunnels or channels leading from the cavities to the apertures on the surface, also lined with a membrane. These granules are present in the discharge; sometimes there is a deposit of a fleshy (may be reddish or dark coloured) substance, containing numerous minute particles (white or red), and occupying the same localities as the above-mentioned granular deposit. Lastly, in the same cavities and tunnels we may find black granules; spheroidal, tuberculated masses of the same colour and radiated in structure, which have been mistaken for melanosis, or blood-clots." The deposit has been examined microscopically by Dr. Carter very carefully, and a description will be found hereafter. It is named by Mr. Berkeley Chionyphe Carteri.

CHAPTER II.

The Nature of Parasitic Disease.

If an appeal were made to the profession, it is certain that a goodly number of different opinions would be evoked in reply to the question—What is understood by the term parasitic disease? Some would hold that the peculiar eruptions, some, that the disease of the hairs, some, that the changes in the epithelium, were the effects of the growth of the fungus. Others, again, would view the parasite as playing an accidental part, or the disease as consisting of a peculiar exudation, as in the instance of favus. If we carefully weigh the evidence of facts as they present themselves to us in the literature of the present day, it should teach us that our estimate of parasitic disease must be composed of three conditions :—

1. The existence of a suitable soil.
2. A pathological lesion (*i. e.*, disease of hairs and epithelium).
3. The cause of such lesion (*i. e.*, the fungus).

Now, then, to make true this assertion.

First, as to the soil.

It is tolerably clear, from general observation, that parasites will not grow upon a healthy state of surface, but demand some particular pabulum to support their continued existence. Under the head of foreign correspondence in the *Medical Times and Gazette*, for February 27, 1858, appears the following: — "In the recent discussion on Parasitism, at the Académie de Médecine, Professor Bouley mentioned some interesting facts. Professor Trousseau had

said that parasites are much more easily developed, and that their number increases much more quickly, in weak individuals than in strong and healthy ones. Professor Bouley mentions many facts in support of this view. For instance, the itch in sheep is extremely disastrous in years of bad crops. The same thing exists for the various parasites of the dog and horse, and for the entozoa as well as for the external parasites. M. Delafond has shown that in a healthy sheep it was possible to put a great number of acari on the skin without communicating the itch; while, on the contrary, the development of the cutaneous affection was rapid if the animal had been weakened by a bad regimen. The conclusion from the facts mentioned by MM. Trousseau and Bouley is, that in cases of the existence of internal or external parasites, it is extremely important to employ a tonic regimen." The same thing is noticed in the familiar case of the caterpillar. The sickly ones are attacked by epiphytes, such as are fed upon improper food, or exposed to the influence of bad hygiene. The diseases of plants illustrate the influence of the general health upon the growth of parasites, for we find these latter attack such plants as have experienced the action of too much or too little moisture, too much or too little heat or light, or such as are over ripe, or highly cultivated and have become succulent or diseased. Chemical analysis has done good service in this as in every other branch of science, and afforded results which teach the very same lesson. Sir H. Davy has left some records behind, touching the analysis of some of the cereals when diseased (by the uredo), in which the productive power of the plants is shown to be considerably diminished. He found that good wheat yielded on an average out of 1000 parts, 955 of nutritious matter; not so, however, the corn derived from diseased specimens, in which the proportion of the latter was considerably altered, in some instances as low as 210, while in others it never exceeded 650 parts to 1000. "Coincident with, if not consequent upon certain meteorological or epidemic influences, alterations are accomplished in the cellulose, or contents of

the cells. Decay follows on those changes; in the decayed or decaying matter parasitic fungi find a nidus for growth and progress equally with the disease of which they are primarily a consequence, and to the extension of which they in their turn contribute."—(Balfour). The same holds good in the analogous case of the growth of vegetable organisms upon the human surface. No one denies for a moment, in the most obstinate and severe forms of tinea, that the health of the patient exerts a marked influence, and that here the existence of a state of blood or nutrition favourable to the development and maintenance of fungi is present, but it is only consonant with all we know to admit that such a predisposition must come into play in the minor cases. A fitting state of soil may exist without the occurrence of any actual manifestation, though the tendency to such lurks in the system.

Robin insists, inasmuch as so few attendants are attacked, that a peculiar soil (*sui generis*) is necessary to the development of parasites, and indeed this is the opinion of those whose practice brings them in constant contact with the tineæ. It is usually taught that tuberculous, scrofulous, and dirty people furnish the best nidus, and it is just these very subjects whose general nutrition is disposed to express itself in non-specific eruptions; and it would appear, from all considerations, that the non-specific eruptive crasis is that which supplies the necessary and only fit soil for fungus growth; the crasis, or *tendency to eruption*, because by no means need there be any actual manifestation present, in the form of eruption, which is the culmination of the peculiar blood state. This is the view which receives support from the examination, not of any one variety in particular, but the whole group of parasitic diseases taken together, and the following are some of the considerations which point in the direction indicated:—

1. The diseases of parasitic nature occur especially in young children and young animals, and are more severe in these. Eruptions prevail in the young: the more developed the eruption, both in degree and kind (*i.e.*, the more marked

the crasis), the more extensive and luxuriant the fungus growth, as a rule.

2. Tuberculous and scrofulous people are peculiarly liable to become affected by the tineæ, and are also peculiarly the subjects of eruption (non-specific). So much do some authorities recognise the connexion, that they have expressed the opinion that the favus crust, for instance, is in truth tubercle. Such an idea could only be entertained in consequence of the existence of the coincident evidences of these diatheses, for the most casual examination of the favus crust must have shown it to be a manifest error. Again, it is indubitable that fungi flourish more completely on the ulcerated mucous surfaces of phthisical patients. My own observation forces me to adopt the conclusion, that in a large number of cases in which parasites play a part, the general health of the patients is decidedly at fault. Many exhibit the phthisical or scrofulous conformation; others are pale, pasty, ill-nourished, or what is known as "delicate." In the minor instances, the patient himself may appear healthy, while in the family history the supposed tendency (hereditary) may be found.

Dr. Hillier, writing recently of tinea tonsurans (*British Medical Journal*, Nov. 23, 1861), remarks: "It appears to flourish more on the heads of tuberculous and scrofulous people than healthy children. Of 25 cases of which I took notes in St. Pancras Workhouse, 10 had the tuberculous diathesis, 2 were decidedly scrofulous, and there was a decided proportion of light-haired, clear-skinned children; two were rickety, and about half in good health." But then the opposite view of the question is strongly supported. If reference be made to Mr. Hutchinson's Report on Favus, *Medical Times and Gazette*, 1859, where this point is summed up, it appears that in many cases there is a want of evidence of any scrofulous or tuberculous condition of the subjects prior to the onset of the favus. Bazin states that it occurs in healthy children. Dr. Jenner, too, has made the like affirmation. Can we say that a subject is *healthy* on whom a parasite is luxuriating?

If we criticise individual instances merely, it appears that such may be the case, inasmuch as the *external evidences* testifying to the contrary may be absent, but even here a modification of blood nutrition, in which the tendency to eruptive manifestations is strong, may exist, and it is not improbable that in lax examinations an error is made when subjects are pronounced healthy, whilst a derivative action is being carried on in the system, as in the case of an extensive favus growth, for the irritation and development of a parasite will "determine from other parts various lesions which would otherwise supervene, in the same way that we are led to believe the various eruptive diseases do which act vicariously by replacing chronic inflammations of mucous membranes, and by taking the place of the swelling and suppuration of the lymphatic glands, perhaps also of tubercle in the lungs, bones and intestinal canal, and swelling and inflammation of the mesenteric glands." Küchenmeister believes otherwise. Where the parasitic growth has commenced at a very early age, and when at the same time it has been extensive and severe, its influence cannot be *nil*, but must very materially modify not only general but local conditions; the amount of secretion which a fungus in an active state of development will "absorb" and get rid of is surprising, and much morbific matter, no doubt, is "determined" towards those parts where this salutary action is being carried on. The dryness of the scalp in favus and tinea tonsurans, where the fungus is abundant, is accounted for in this way, and if the parasite be destroyed effectually, before general remedies have altered the soil, secondary eruptions and free secretion often remain, showing clearly (since the local irritant is removed), that the fungi probably act in the manner indicated, and that the tissues situate at the site of the original parasitic growth are particularly apt, after a time, to assume a kind of elimination, this *habit* having been induced by the fungus itself. Upon the same principle, it has appeared to me, that in severe cases of tinea, swelling of the glands in the region near is comparatively uncommon, as though there existed some special preventa-

tive. I have had under treatment lately a case of favus of some twenty or more years standing, in which the general aspect of the subject certainly led me to expect decided local signs of scrofula, but these were markedly absent. It is also quite legitimate to judge the crasis somewhat by the concomitant features of any case: *ex.*, the misery, privation, unwholesome damp dwellings, the absence of fresh air and exercise, which all authorities agree have generally played upon the system of those attacked by favus, and which are quite capable of helping out the non-specific eruptive crasis.

In Dr. A. T. Thompson's work on Diseases of the Skin, under the head of Porrigo favosa, are the following:—

"Case 18, æt. 12, a pale, thin girl; she had been for many months badly fed and ill-clothed."

"Case 19, æt. 5, a boy of pale complexion, relaxed, flabby muscles, and general unhealthy aspect. Before his admission, he was living chiefly on bread and butter and tea, and scarcely ever tasting animal food."

"Case 20, æt. 4, a delicate boy, complexion pale, belly tumid."

"Case 22, æt. 18, was of strumous habit."

"Case 23, æt. 12, of a strumous habit, languid circulation and extremely indolent disposition."

Cases marked 18 and 19 were probably impetiginous. In Mr. Hunt's little work on Skin Diseases, case 36 is that of a "girl aged 17, of stunted growth and cachectic appearance, who suffered from porrigo for four years, and the disease persisted in spite of all remedies." And case 37 is that of a "rickety child four years of age, with the scalp nearly covered with a thick tenacious crust of porriginous character, which appeared in early infancy," the child being pale and emaciated; no ultimate cure took place.

"It cannot be denied," says Mr. Wilson, "that the disease is most easily excited in a weakly and unhealthy state of system, and particularly in children of a scrofulous habit." Parasitic disease is common in dirty people, who certainly afford a fair quantum of vesicular and pustular manifestations. Hebra lays great stress upon this feature

of dirtiness as a cause of favus, and it has been supposed to account for the rarity of the latter in the upper classes; it must be remembered, however, that other hygienic conditions, before indicated, come into play among the lower ranks of society, and are probably more powerful as predisponents.

3. The most severe and obstinate forms of tinea are such as are implanted upon already existing *eruptions*.

4. Experiment (Hannover and Stilling) has shown that the more diseased the subject the better the artificial introduction of the parasite is accomplished.

5. The frequent coincidence of minor forms of parasitic disease, and minor eruptive states, recurring hordeolum, furunculi, and the like.

6. The amount of parasite and eruption is in direct ratio; this may fairly be concluded from a general survey, the eruption being regarded in its kind and amount as an index merely to the degree of crasis present.

7. In regard to adults especially, though the distinct signs of the eruptive habit are oftentimes wanting, still, from analogy, there is good reason to believe that the tendency modified by age (a most important particular) exists. In many cases, there is distinct disease in addition to the parasitic patch. Very frequently the skin is harsh, dyspepsia of an obstinate kind present, and little patches or dottings of erythema, herpes, quasi-eczema, pityriasis, and such like. It is my habit to associate with cases of tinea in the adult that kind of dyspepsia in which the fluid contents of the stomach are sour and markedly acid; and my conviction is that one of the prevailing characters of the parasitic diathesis is a deficiency of alkali, or such a state of system as is consequent thereupon. It may possibly be that the deficiency of alkali helps out the mal-assimilation of fat, the exhibition of which is of so marked a benefit in the treatment of all varieties of tinea. The action of the alkali is certainly not a direct chemical one. Now, its deficiency is one of the leading features of the non-specific eruptive crasis, and the facts above mentioned afford another argument, though not a powerful one, in support of the view under notice.

This belief in the existence of dyspepsia in many cases of tinea, had become firmly established in my own mind before I had become acquainted with the valuable summary of Mr. Hutchinson on "Alopecia Circumscripta," published in the *Medical Times and Gazette*, February 13, 1858, and which had, until very recently, altogether escaped my attention. Mr. Hutchinson's observations show that of 42 instances, 11 were those of adults of 20 years and upwards, and of these 11, three were noted as having dyspepsia, besides one of 14 years, and another of 16 years of age. (The cases were numbered 2, 34, 36, 8, and 40, respectively.) The report contains much interesting detail, particularly as regards the general health of those affected. It must be borne in mind that this disease is the *least expressed form* of tinea, and the patients attacked by it (if the general health of those in which the other severer types occur, be, as asserted by many, quite good) should certainly show themselves to be, in the mass, of good constitution and nutritive power; but what says Mr. Hutchinson's Report? of the remaining 8 of the 11 adults, 1 (No. 41 in the Report), at the time of attack "was not so well as usual," health "fair;" 2 (No. 37), "good;" 3 (No. 28), "states she had a bad scald head, health fair;" 4 (No. 27), "good;" 5 (No. 26), "good;" 6 (No. 23), "had a ringworm in infancy, and the hair did not grow well afterwards;" 7 (No. 21), "good;" 8 (No. 4), "fair, not feeling well;" of the remainder, "Nos. 8 and 40, were dyspeptic, No. 1 a little losing flesh." "No. 3 looks underfed." "No. 5 has had water on the brain, which has left a squint; almost well when the disease began." "No. 7, losing flesh." "No. 10, delicate, pale, clear skinned." "No. 13, delicate, ill-nourished, starved-looking." "No. 15, strumous." "No. 17, rather delicate." "No. 18, has been getting thin, looking delicate, has lost a little flesh." "No. 22, pale, and delicate." "No. 32, cachectic."

Certainly no one can infer from this report that the subjects, even of the mildest form of tinea, are healthy as a rule; and as the majority of these patients applied for relief some

considerable time after the patches of alopecia appeared, it is by no means unlikely that much stronger evidences of an eruptive crasis may have existed as part of the causation of the disease, at any rate as a predisponent state.

It is worth while to notice another feature. Alopecia circumscripta is *absolutely* more common in children than adults, but *relatively* more frequent in the latter and less frequent in the former, as compared with other varieties. For example, of 42 cases of any other than tinea decalvans would there be, as in the latter, 11 in adults of 20 years of age and upwards? Now, what means the truth of the negative? It cannot be that the disease is special to adult life, for the foregoing statements deny that; it is the same in every way as that which occurs in young life. Why do not the other varieties of parasitic disease occur with equal frequency? Age alters the condition of soil, the eruptive crasis has diminished in force, and less provision is afforded for the development of fungi, whose elements are present in very scanty measure, and the aspect of the patch of disease is changed by the absence of eruption; there are no vesicles, no pustules, and rarely furfuraceous desquamation. In the young the disease (tinea decalvans) presents itself under the like condition—*i. e.*, where the "crasis" is little, if at all, marked, at least, so as to be appreciable by the criteria we possess at present. In two cases, marked 23 and 28, the disease had altered its character, in the one case from "ringworm," and in the other from "scald head," into tinea decalvans, for it does not appear, as Mr. Hutchinson seems to admit, that in either the original malady had been eradicated. One had existed seven and the other sixteen years, when first they came under observation.

In case No. 7, it is said that two sisters had true ringworm. It appears, then, that what would become tinea tonsurans, and the like, in the young, forms tinea decalvans in the adult, in consequence of the difference in the character of the soil in the two cases; and whenever in the child the proper nidus is below par, so to speak, that is, similar to that of the adult, tinea decalvans results. This is the view to which

modern research is tending, and *is merely an illustration* of a general principle in regard to the tineæ as a whole.

8. The beneficial results which ensue from the exhibition of arsenic (which are undoubted) may be adduced as an additional argument; for the remedy in question acts not directly by destroying the fungus (for the latter grows readily and steadily in arsenical solutions, *ex.* Liq. arsen. chlorid.), but indirectly by changing the character of the soil, and the soil which it changes, and for which many regard it as "specific," is that furnished by the non-specific eruptive crasis. Some go so far as to assert that local remedies are of little importance compared with the use of arsenic—a dogma which experience renders wholly untenable. A single application of a parasiticide will cure many cases, and general remedies fail in others. The case of favus, before referred to, has been literally "poisoned" with arsenic and other remedies, and "was as bad as ever," when general means had been fairly and fully tried.

9. The connexion between certain acute specific and parasitic diseases, such of the former as are likely to be followed by the evolution of the tuberculous diathesis. Several cases have come under my notice of late (in which this point seemed to be particularly exemplified) of families affected by tinea tonsurans very badly after hooping-cough and measles, which, of all others, are most liable to be followed by the development of tubercle, and frequently various eruptive manifestations. In a family, in which tinea tonsurans occurred, varicella made its appearance in one of the members, and the patches of tinea were very bad and obstinate where the bullæ of the latter had burst, whereas in the other children the ringworm was comparatively mild. Moreover, it is worth noticing, that the subject in whom varicella occurred is liable to be attacked by a scaly eruption. The relation between the blood diseases named and the tineæ is not simply a coincidence, because the latter in the co-existence, are markedly bad, and difficult of cure.

Such are briefly the facts—some of the facts—which seem to point to the non-specific eruptive crasis as affording the

fitting soil for the growth of any fungus. This point is one which admits of very much hypothesis, and much research is needed before we can arrive at a scientific result; but for clinical purposes there is no lack of guides to treatment, and it may safely be concluded that such as are mostly predisposed to exhibit the tuberculous and non-specific eruptive crasis are also the most likely to nourish parasites, and the same general treatment is applicable to the two cases. Bazin, it would appear, agrees with Robin in considering the soil as one *sui generis;* but this opinion, as far as one can gather, is unsupported by any facts or arguments. Bazin says, "a parasitic affection is one of the skin, produced directly by the parasite itself, or symptomatic of a parasitic malady. A parasitic malady is a *particular state of organism* which shows itself by the presence of a vegetable or animal growth, and which manifests itself by the assemblage of symptoms, lesion, and an affection." Syphilis has been associated with the occurrence of tinea tonsurans, and even tinea decalvans; but this relation has always appeared to me very doubtful. Given, a patient affected with syphilis, and the result may be a syphilitic eruption, which may become the seat of a parasitic growth; but in this case there are peculiar characters by which the syphilitic is known from the non-syphilitic variety, and which make the case differ entirely from the ordinary forms of the tineæ.

Next in order for consideration comes *the pathological lesion.*

To those who contend that parasites are accidental products, the following arguments (which show also that disease of the hairs and epithelium is the real parasitic lesion) may be presented:—

1. Nothing but the growth of a fungus can produce the ravages upon the hairs and epithelial tissue, seen in the tineæ.

2. Whenever the parasite is absent, the damaged hairs, &c., are never found.

3. The disease will certainly not be cured unless the parasite be destroyed or die.

4. The fungus in a state of growth need be the only abnormal state present in addition to the disease of the hairs and epithelium. *Ex.* Tinea decalvans.

5. The disease of the hairs and epithelium is *pathognomonic* of a fungus growth. In parasitic disease other structures may be involved, but not necessarily; eruption is oftentimes present, but it must be remembered that this is evoked by a host of irritants besides fungi; whereas nothing but the growth of the latter can produce the damaged hairs, &c., *which is the parasitic lesion, par excellence.* Take away the latter, and nothing diagnostic of the ravages of a parasite remains: but, on the other hand, remove all *eruptive*, and the parasitic disease remains in its entirety. Let me illustrate my position. Take the case of the chronic skin diseases. Good observers say, that in cases of psoriasis, lepra, eczema, ichthyosis, lichen, &c., they sometimes find fungi, and sometimes fail to do so, and they infer that the presence of parasites is accidental. Now, herein is contained the confusion of *eruptive and parasitic* diseases which gives rise to the great difference of opinion existing in regard to the part played by fungi as a cause of disease. All these cases of chronic skin diseases in which fungi occur are complex examples; there is present an eruption manifesting the existence of a peculiar blood state, and when fungi also co-exist, a diseased condition of the hairs and epithelium; but inasmuch as the hairs are few and small, the pathognomonic lesion of tinea is not marked sufficiently to attract the naked eye, as in tinea tonsurans, for example. Parasitic disease cannot be looked upon as of an eruptive nature, but usage has schooled us so as to make it a matter of difficulty to regard it as really non-eruptive. The preceding remarks contain the answer to the question, What is parasitic disease? By tinea (the generic term for parasitic disease of the surface) is meant such a malady as is due to the presence of a vegetable organism in a state of growth, producing *characteristic* effects upon the hairs and epithelium of the part attacked, and not until the fungus is implanted and growing upon the affected spot can we say that what we call the disease is present, and never until the spread of the

vegetation occurs do we get those intimate changes which damage the hair follicle and contents; moreover, a condition necessary to parasitic growth is the existence of a particular soil, probably that afforded by the non-specific eruptive crasis.

Many dermatologists suppose, that before any of the elements of a parasite take hold upon the surface there is a definite change in the nutrition of the latter—that hypersecretion of epithelium, or the presence of a certain blastema is to be found at the spot where the fungus subsequently forms. I do not doubt that this is true of a certain number of cases, and fungi flourish remarkably well when implanted upon pre-existing eruption (secretion); but, assuredly, in the majority of instances, no *physical* change has taken place prior to the planting of the fungus. In the case of the potato disease, botanists have noticed a peculiar change in the cells of the plant (an augmentation in the granular contents, and so on) before any fungus is visible; but even here many good authorities suppose that this is the *consequence* of the presence of the botrytis. The hair and epithelium are nourished by blood possessed of certain properties (which favour the growth of the parasite), but the differences induced in their nutrition do not seem to be appreciable as a rule by physical characters; it cannot be doubted, however, that good observers have seen hypersecretion (by this is meant rather changes immediately connected with cells and cell-contents) apparently precede, but, at the same time, it is not at all improbable that they have also overlooked the early or granular (stroma) condition of the fungus, which suffices to account, by the irritation produced, for the excessive formation of epithelium, and the presence of effused fluid, and the like. The question has been put to me, what is the first stage of the disease, the implantation of the fungus, or the diseased condition of the surface? The reply is clear—there must be a suitable soil which may, but generally does not, present evidence of its existence before the implantation of the parasite, which, however, calls it forth by the irritation set up. The difference involved, however, to the practical physician, is of little moment; the *antece-*

dent physical change implies merely that the crasis is more or less well marked, according as the secretion is abundant or sparse, epithelial, granular, or blastematous.

Some of the foregoing statements deserve some additional notice. It has been said that the pathognomonic lesion is to be found always in connexion with a fungus in a state of growth, and it is now universally admitted that a damaged state of hairs and an epiphyte are found in tinea favosa, tinea tonsurans, tinea sycosis, and tinea polonica. Great doubt has been expressed with regard to tinea circinata, as to the existence of a parasite. I have examined a large number of cases, and very rarely failed to detect the trichophyton, especially in the early stages; and in the instances of failure, it has probably been overlooked from want of careful search, or it has died out. The fungus is best seen by taking some of the *epithelial scales* at the circumference of a recent patch, placing them under the microscope, with the addition of a little liq. potassæ, and allowing them to soak for awhile. My drawings (*vide* Plate II. figs. 2 and 3) show some very curious forms of mycelial threads. If *the hairs* of a patch of tinea circinata be taken, placed on a slide covered with thin glass, and floated out very carefully by the addition of some fluid, very frequently a delicate network of mycelium will come into view under the microscope before the hair itself gets into focus; this is a state which is often missed from want of care; moreover, the hairs may be infiltrated with, and bulged here and there, by collections of spores—more than this, actually split up by the growing fungus; of this latter condition a drawing is given (Plate I. fig. 7). The hair is one of several taken from a patch in the arm of a young girl; they had become broken off and covered over by a little operculum formed by the secretions of the part, and thus retained in the follicle a considerable time, so that the fungus had opportunity to develope, and the appearances under the microscope were exactly similar to those seen in tinea tonsurans. Alopecia may be a result of tinea circinata.

There is a condition of fungus which has not attracted

the attention of observers, but which in itself is ample evidence of the presence of a parasite, viz.: a minute granular infiltration, or nuclear form, which, indeed, is identical with the stroma of fungi, and which I have been able to show in preparations prepared expressly for the purpose, may germinate into the more perfect state of sporule or spore.

Tinea sycosis offers no exception to the rule that the hairs are affected by the fungus; and reference to this disease is here made to offer a denial of the prevalent opinion that the microsporon mentagrophytes is confined to the follicle and the exterior of the root of the hair. I have seen the hairs affected as in tinea tonsurans, the free shaved ends also split up; and in one case which came under my notice, there was, at the distance of a quarter of an inch or more from the follicle, a little dark knot, which was found to be due to a mass of epithelial scales around and associated with a diseased state of the shaft of the hair, in conjunction with some well-developed round and oval (nucleated) spores, and mycelial threads, invading chiefly the epithelial mass. The granular or nuclear form of fungus may likewise be present in sycosis in addition to other, or as the sole, evidence of the existence of the microsporon. The discussions in regard to tinea decalvans have resulted in establishing a wide difference of opinion, and the presence of a parasite proper and peculiar to this variety of parasitic disease has been most strenuously denied. *A priori*, it seems very improbable that simple idiopathic atrophy should account for its circular form, so characteristic of fungus growth. All the concomitants of the actual malady tell in the same direction. That the disease must be truly parasitic, appears certain from a consideration of the close relationship subsisting between it and other tineæ, both with regard to the mode of origin and progress. The opposite view only creates an additional and unnecessary difficulty, for it demands an explanation of the cause of the peculiarly localized atrophy, why this disease occurs in young children in whom the hair round about the actual diseased patch is vigorously growing. And it is contradicted

by Wagner's examinations, which have shown that the formative apparatus of the hair is not damaged, but remains in its proper proportion and development. Moreover, the follicles are distinctly seen; it must be clear from this, that something more than mere atrophy is at work. Besides, when we know that a fungus has been detected, and that it is the most efficient cause in producing loss of hair, it is scarcely fair to refuse to entertain the existence of any causation other than atrophy, which leaves us in still greater difficulty than before. It is true that atrophy, and consequent loss of hair, result from and form part of general wasting and debility without the intervention of the action of a parasite; but there is an entire distinction here in form and character. The alopecia is not *circumscribed*, and in contrast to a *natural state of adjoining parts* and a proper condition of follicle. Good observers have failed in some instances always to detect the microsporon audouini; the same has happened repeatedly to myself. Still subsequent observation has by no means convinced me that a fungus undiscoverable at the time of examination has not been at work, and caused the atrophic state of the hairs. Care must be taken to select cases of true tinea decalvans, for several allied, or rather similar, states have been classed under this term. Every bald patch is not the disease in question, since many of these are the *results* of any and every other variety of tinea; and of course there need be no parasite found, parasiticides having destroyed all traces of it. Neither can atrophy alone be considered sufficient to mark tinea decalvans, for this occurs with equal frequency in all the tineæ. The distinctives of the true disease are, the fact of its being *idiopathic*, and not secondary, the absence especially of eruption and secretion, the less severity of the affection of the hairs, in consequence of which they do not become brittle and break off, but remain till the follicle can retain them no longer, and this loss, which seems to be the commencement, is in reality the final stage of the disease, which has been in existence (unrecognised) for some time prior to the occurrence of the alopecia; and lastly, it is the least acute of any. I have

taken great pains in the examination of this disease, and have of late, as a rule, almost invariably found in the early condition, or what is almost the same thing, at the extending edge of the patch, the fungus; and my belief is, that future research will show the loss of hair to be the destructive result of the growth of the microsporon; that the latter is not in a luxuriant condition, but frequently dies out from sheer want of pabulum; that the follicle often overcomes the antagonism exerted by the epiphyte, and in consequence it is not uncommon to meet with a tolerably healthy root and a diseased shaft.

Troublesome itching, branny desquamation, heat of head, and slight erythema, or puffiness of the scalp, precede the loss of hair at times—symptoms and signs which are diametrically opposed to the theory of atrophy. I am far from denying that the state of general health and the local condition of the scalp have any influence. With regard to young children it seems quite a contradiction, but in the case of those of more advanced years, if the growth of the hair be weak, very little parasite will suffice to bring about marked effects; at the same time, the clinical histories of the tineæ as a whole, and tinea decalvans as a separate affection, scarcely warrant us in attributing the peculiarly localized alopecia to simple idiopathic atrophy of the hair bulbs.

The microsporon is at times found at a varying distance from the follicular part of the hair, the shaft being surrounded by epithelial and parasitic elements, and itself dry, brittle, and atrophied; moreover, it is possible, and indeed probable, that the parasite may be left behind in the follicle when the hair is extracted in consequence of its loosened state. Again, the appreciation of the "nuclear form," determines the existence of the otherwise supposed absent fungus. Practically speaking, at the time of the onset of the alopecia, the fungus had died out, but the concomitant states may be very suggestive. In the spring of 1860, a patient of mine had loss of hair, from what could be only tinea decalvans, conjoined sycosis, and tinea circinata of the back of the wrist. Neither severe, but all distinct, in ad-

dition to chronic dyspepsia, with marked acidity. Very recently I saw a patient under Mr. Hunt's care, in whom tinea decalvans, tinea tarsi, and sycosis, co-existed. The absence of secretion involves absence of moisture, heat, and shelter, which very materially aid the development of fungi. If reference be made to Mr. Hutchinson's Report, it will be seen that in the majority of cases, the disease had existed years before coming under observation, and in no instance less than a month. Now, this must be taken into account in estimating the value to be put upon the microscopical examination of the diseased patches, as determining the presence or absence of a fungus, for this latter had probably died out in many of the cases recorded by Mr. Hutchinson.

In 22 of 42 cases no microscopic examination was made. Mr. Hutchinson has since found the microsporon audouini in the scales scraped from the surface of the circular bald patch.

In a case which I saw in consultation not long since, and which had been pronounced to be non-parasitic, but yet named alopecia areata by an authority, I demonstrated the existence of fungus elements in abundance, most satisfactorily, in the furfuraceous scales scraped from the extending margin of disease. The more the history of tinea decalvans is examined, the more certainly will failure in the detection of the fungus be found to be due to the want of proper care, not only in the actual microscopic examination, but also in the selection of proper instances of disease. In tinea versicolor (chloasma), though the preponderance of the disease is located in the epithelium, yet distinct evidence of the infiltration of the hairs by sporules is by no means of exceptional occurrence; the shafts are oftentimes marked by little bulgings here and there, the consequence of small local collections of minute sporules, which look at first sight like pigment granules, but in course of time develope into the condition of the typical elements of the fungus. This state, as one would be led to expect, considering the minute character of the hairs of the part attacked, is never so distinctly marked as in other varieties of tinea, and generally

left unnoticed by writers on the subject. Dr. M'Caul Anderson, in his work, however, remarks, "the spores and tubes are found on the hairs, and in them, though not to the same extent as in herpes tonsurans."—(p. 93). I have seen the ends of the hairs split up, and exhibiting the separate component fibres as in tinea tonsurans, so that in this variety we find the pathognomonic lesion, that which nothing else but a fungus growth can produce, the damaged hairs and epithelium.

Pityriasis capitis is certainly, as the rule, non-parasitic; when, however, a fungus is present, the hairs of the affected part will assuredly be found in a state of disease. Some authorities (Dr. Bennett, for example) regard pityriasis as a modification, in many cases, of favus, and Dr. W. Pirrie, (*Lancet*, December 3, 1860) adopts this view. The achorion no doubt attacks the epithelial scales, produced in large quantities in favus, but there is no just ground for establishing this as a separate disease, for it forms part and parcel of the other, which, seated at the hair follicles, includes changes in the epithelial tissue; and when the achorion has been destroyed, and the scalp is returning to its healthy state, in consequence of the long-continued irritation, various eruptions hold on for some time, and one stage in the cure may be a pityriasis. At other times, and in other instances, the latter is not necessarily dependent upon the growth of a parasite, but simply the result of certain abnormal variations in the nutrition and circulation of the scalp, brought about by different local and general agencies other than fungi; and thus, in like manner, in the other varieties of tinea, pityriasis may arise as an after result, scarcely as the immediate consequence of the growth of a parasite, and cannot really be entitled to the name parasitic. The earliest stage of some of the tineæ may be represented by slight erythema and subsequent desquamation, as in tinea decalvans, but this is quickly succeeded by the full development of the disease which is thus foreshadowed; the same may be said of tinea circinata with equal truth. With regard to idiopathic parasitic pityriasis, non-coexistent

with, or not connected as a mere stage of some form of tinea, but the direct and sole result of the growth of a fungus, I have little evidence to offer, though there is no reason why it may not exist.

Mr. Jabez Hogg has recorded some very interesting observations touching the presence of fungi in the scaly diseases, and regards the former as accidental products. In these cases, the sporules are small and few, the mycelium in the preponderance, and the diagnostic lesion marked indistinctly on account of the paucity and small size of the hairs. The presence of the nuclear stroma has much significance in "chronic skin diseases." I think there will be found a decided difference in the microscopic appearances of the hairs in scaly diseases with, and those without, the presence of parasites. Where the fungus is absent, the structure of the hair is histologically defined as to its elementary parts, though perhaps ill-developed. Where the fungus is present the root is atrophied, the division of central and cortical parts lost, and the shaft frequently split up. (The epithelium is of course diseased in all these instances.) There appears to be some interference with the functions of the formative papilla at the bottom of the follicle. Mr. Hogg's observations will be found in the *Microscopical Journal*, vol. vii.

In 7 of 13 cases of psoriasis the fungus was found; in 5 of 7 cases of lepra, in 1 case of ichthyosis, in 3 out of 4 cases of lichen, in 4 out of 6 cases of eczema, in 4 out of 7 cases of tinea tarsi, and in spilus. It does not appear that special attention was paid to the condition of the hairs.

The proposition which necessarily follows from the foregoing remarks is this: *Nothing but the growth of a fungus can produce distinct damage of the hairs* (*and epithelium*), *which is the pathognomonic lesion of parasitic disease.*

The next point for consideration, viz., the relation of parasitic growth and eruption, has been to some extent anticipated. As before stated, the non-specific eruptive crasis appears to afford the fitting soil, and it now remains to inquire how far the coincidence of the eruption itself and

the fungus can be looked upon as cause and effect, for much of the uncertainty appertaining to the subject of tinea arises from the confusion of *eruptive* with *parasitic* disease.

1. It is clear from the history of tinea decalvans that the presence of the actual eruption is unnecessary to the evolution in full force of parasitic lesions.

2. The characteristic effects of tinea are never caused by eruptive disease alone.

3. The eruption may exist before the appearance of a fungus.

4. The growth of the parasite may, nevertheless, act in like manner to all local irritants, and give rise to eruption.

The relation, then, of parasite and eruption is rather a *concomitance*, the latter, in its degree and kind, being an index of the state of soil present.

Mr. Hogg, referring to chronic skin diseases, says that the growth of fungi is not necessarily pathognomonic of any special disease, because they have been observed in all kinds of skin disease. This is quite true *quoad* the eruptive manifestations themselves, but, as before observed, not as concerning *the disease of the hairs, &c.* It will be found that as more or less eruption, so a corresponding amount of fungus is present, and it appears to me that we can generalize as to the ratio of parasite and eruption. Take the series tinea favosa, tinea tonsurans, tinea polonica, tinea decalvans, tinea versicolor, and tinea circinata, and the point will be found to be substantiated by the detail of each variety. Secretion aids by its intrinsic qualities of heat and moisture, and in affording protection to the epiphytes.

The conclusion, then, to which facts seem to converge, comprehends eruption as the index to the existence in the best possible degree of the suitable pabulum, and as a concomitant, but not a *necessary* part, of parasitic disease.

CHAPTER III.

General Outline of Diseases other than the True Tineæ complicated by the Growth of Fungi.

There are certain general features which, taken collectively, afford presumptive evidence of the existence of fungi. Now, as many of these (naked eye characters especially) are possessed in common by *uncomplicated* skin diseases, the only real means of arriving at a correct estimation of any given case is microscopic examination, and they who discard the latter in the diagnosis of skin affections are infinitely less competent to undertake treatment than are they who make use of this method of detecting an additional source of local irritation. The following are the prominent points in the *combination* of eruptive and parasitic diseases, more particularly in such of the former as are *produced or prolonged* by the presence of a fungus.

1. *Unsymmetrical character.*—An eruptive disease may be symmetrical, and the seat likewise of a parasite, but, generally speaking, in those instances in which a fungus protracts the cure, and opposes the good effects of general treatment, the eruption is unsymmetrical; and this latter character should always suggest the probability of the existence of some local irritant. A symmetrical arrangement may result from inoculation, for instance; the fungus may be transplanted from one to the other leg by mere contact. Syphilitic, as contrasted with parasitic diseases, are of course symmetrical.

2. *Circular form and centrifugal mode of increase.*—This is a valuable test in the milder instances of disease; in the

severer forms, the local irritation is widely felt, acutely shown, and free eruption modifies and obscures the original circular character. In all parasitic diseases the primitive form is a circle, and unless special counteracting influences come into play, this is preserved throughout the course of the disease. Coalescence is the chief agency by which deviation is brought about; the unequal growth of mycelium is another. In the early stage the circular character is to be noticed when the mischief is limited to, or rather commences at, the hair follicles. They who have paid much attention to skin diseases are familiar with little patches of what may be termed the "furfuraceous herpes," and which are of frequent occurrence about the chin, shoulders, arms, and legs of children especially. They approach at times erythema circinatum, at others, tinea circinata, so closely as to be really identical with these respectively; indeed, there are transitional forms between the two above named. Now, these patches are mostly unsymmetrical and circular, and I have, over and over again, found the trichophyton attached to the epithelial scales.

The centrifugal mode of increase need not be dwelt upon.

3. *Obstinacy.*—Very many different diseases possess this feature, of course, but inasmuch as they are symmetrical, the prolongation evidently depends upon the general condition of the system at large. I have seen, however, unsymmetrical cases which were kept up by some local irritant, and the troublesomeness in the cure was brought about from ignorance of the nature of the case, or the difficulty in reaching effectually the elements of the fungi. An obstinate unsymmetrical disease is often parasitic.

There appears to me to be much contradiction in the use of the terms acute and chronic as applied to the case of epiphytic affections. Many call favus acute, whereas its duration is much longer on the whole than any other disease of like kind. Again, many eruptions comprised under the term "chronic skin disease" (such as lepra, psoriasis), complicated by parasitic growth, are oftentimes the most easily cured. Do the terms obstinacy on the one, and acute and

chronic on the other hand, refer to different *stages* respectively? Obstinacy must have reference to the duration and treatment, and is so far analogous to the like sense of chronic. Should acute and chronic be limited to the *stage* of disease? If so, when does the one begin and the other end? These remarks are suggested by the fact that the two terms in question have come to signify *kind*, and not merely *stage*. If we compare together the various eruptive and parasitic diseases, it will be found that the severer cases of the latter deserve more truly the title of chronic; this is especially true if we leave out of the question the symmetrical group.

The chronicity (using this term as equivalent to obstinacy) of any variety of parasitic skin disease depends upon—

(*a*.) The existence in a greater or less degree, and the continuance of, a fitting soil.

(*b*.) The inability to reach the fungus with parasiticides, chiefly in consequence of the disease having existed some time before treatment has been commenced.

(*c*.) The amount of hair follicles. Where these are most abundant and fully developed, there will the parasite be in greatest quantity, and most perfectly implanted and protected.

(*d*.) The non-discovery of the fungus, as is often the case, in the scaly varieties of skin disease.

4. *Pruritus at the outset*.—This is not a peculiar but a suspicious mark of the presence of a parasite; it is accompanied by more or less erythema at the commencement, which assumes the form more or less of rings, which are ephemeral; warmth and perspiration together increase the irritation. No very definite conclusion can be drawn, however, from the consideration of this state alone.

5. *Colour*.—The sulphur colour of favus, the white fringing around the follicles in tinea tonsurans, and the branny look of chloasma, require no comment. The appearance of bright red circles, or rings, which are replaced in their central part by light brown tints, while the original margin extends centrifugally, is characteristic of parasitic growth. *Ex*. Tinea circinata, erythema circinatum, or slight tinea tonsurans.

The colours of some parasitic and syphilitic cases approach each other; indeed, the two diseases may be associated. The former scarcely presents the peculiar dull red of the latter. Error can only arise in instances of symmetrical eruptions complicated by parasites. For example, I have known instances of so-called chronic eczema apparently dependent upon the irritation produced by the trichophyton, and affecting the insides of both knees, present much of the aspect of syphilis, but the history of the cases showed that the one patch was probably consecutive in point of time, and produced by the transference of the fungus from the opposite knee. Again, in such cases the patches are unequal in size to a marked extent, and the character of the surface is not uniform. There are little spots of tolerably healthy skin showing out in the general patch. The disease is seen to be seated, too, at the hair follicles most distinctly, as well as in the general tract of the skin. In both the parasitic and syphilitic cases the margin is well defined, and the *character* of the eruption is not *typical*. The general condition of the system and the symmetrical or unsymmetrical nature of the disease are the two chief guides which rarely fail. The microscope will aid, of course, but does not define, the instance of a parasitic and syphilitic combination. Pruritus is much more frequent in parasitic instances. Some of the furfuraceous cases, under certain circumstances, present very distinctly a similarity to the syphilitic tint, and Dr. M'Caul Anderson mentions this fact in speaking of chloasma. I saw this most perfectly exemplified in a case of "herpes circinatus," some time ago, in which there existed four patches on the forehead of a circular form, of a dullish red tint, and dotted over with imperfectly formed vesicles and scales. The margins were well defined, the trichophyton was detected in the minute hairs and epithelial scales; the patient fainted whilst under examination, and when the blood was absent from the face, the patches presented a most perfect copper colour; indeed, that with the defined margin and the scaly centre might have misled any one. In the course of another day the tint became paler, and the disease, which

was in great degree unsymmetrical (chiefly on the right side) had altogether disappeared in a little more than a week. It is only in the earliest stages that this similarity of colour is noticed, as a rule.

6. *Contagion.*—All parasitic diseases are contagious, and yet good authorities deny it. There are certain necessary conditions for the growth of fungi; of course a favourable nidus must exist, and a certain degree of moisture and heat, the absence of which no doubt explains the unsuccessfulness of many attempts at inoculation which have been recorded as proofs of the non-contagiousness of parasitic disease. Contagion is denied, especially in the cases of chloasma and tinea decalvans; but Mr. Startin (*Medical Times and Gazette* for 1853), very clearly established its existence in the first-named; and Dr. M'Caul Anderson (p. 83), furnishes like evidence, and quotes cases by Hardy, Gibert, and others, to prove its possession by the latter; and Cases 42 and 43 in Mr. Hunt's work are good examples.

7.—Fungi all produce disease of hairs and epithelium. This pathognomonic lesion has been noticed.

8.—A spontaneous cure is rare, and only takes place when the soil is insufficient to give a proper supply of pabulum for the continuance of the growth of the parasite; hence spontaneous cures are most commonly observed in tinea circinata.

9. *Occupation of the subject attacked.*—Persons exposed to the action of heat are frequently attacked by parasites. *Ex.:* workers in iron manufacture, cooks, stokers, engine-drivers, and the like. It is also asserted, that those much engaged in the use of yeast are liable—*ex.* brewers. In schools, where the means of transmission are abundant, tinea is common. The germs of the fungus may be derived through the medium of the air, actual contact, or inoculation, and the spread favoured by scratching, which re-implants the fungus, and the use of the same toilette, hat or cap, by several boys.

10. *Seat.*—Parasitic growths never take hold upon any

part in which hair follicles are absent. The chief general seats are the head, beard, chest, belly, rarely the lower limbs; in the upper extremities, in the neighbourhood of the wrists especially, and the other aspect of the forearm. Various opinions have been held with regard to the primary seat of the fungus growth. All recent observation proves it to be none other than the Malpighian layer of the epidermis; and this is equally true, not only of the tineæ more truly so-called, but also of eruptions complicated by parasitic vegetations. Of course, the germs of the fungus, whatever it may be, must first of all find their way to the latter structure; and this is accomplished by means of the openings of the hair follicles. Wedl originally taught what is perfectly true, that the very first spot at which any perceptible fungus can be detected, is a little way inside the follicles near the opening of the sebaceous glands. It is here that the plant first finds protection and lodgment, though it quickly takes to the Malpighian layer as its germinating locality, which may fairly be called its primary seat. There are, no doubt, occasional exceptions to this rule; but these are due to very special causes, such as the existence of abrasions, &c. From its primary seat, so far as the surrounding parts are concerned, there is no limit to the extension and invasion of the parasite. In the *Lancet*, December 3, 1860, Dr. W. Pirrie argues against the view which looks upon the hair follicles as the seat of the disease in favus for the following reasons:—

1. On removing the crust, the only thing seen is a slight depression on the derma, without abrasion, which would not have been expected were the crust an exudation of the hair follicle.

2. The crust can be drawn over the hair, and the latter left in the follicle.

3. Permanent baldness does not invariably follow favus, which would be the case if the primary seat were the follicle.

4. The occurrence of the disease in parts where it is impossible to detect any hairs piercing the crusts.

Dr. Pirrie, moreover, looks upon the favus matter as "an exudation on the surface of the derma." Is it not just possible that this opinion, which, however, is quite set aside by most dermatologists, may have led to a little too strained an application of the above arguments? Neither of them proves anything against the fact of follicles being the spot where the parasite primarily takes hold upon the system. With regard to the first, no one contends that the favus matter is an exudation from the follicle. Again, the hair is merely lost when the papilla is destroyed or damaged, and baldness is only permanent where the formative apparatus fails to recover some or all of its healthy activity. So far as my reading goes, no case can be adduced to show that favus ever occurs in a part devoid of hairs. Dr. Anderson, in relation to this same point, refers to the case of a favus cup observed on the glans penis by M. Lebert, which Bazin proved offers no support to the exceptional opinion adopted by M. Lebert and accepted by Dr. Pirrie.

Speaking, then, of the ordinary forms of eruption, we may suspect the existence of a parasite if the disease be unsymmetrical, circular, increasing centrifugally, obstinate, attended with pruritus, of a brownish tint; if there be any evidence of contagion, and it occur in the inmate of a school, or in those exposed to great heat; if it be seated where hairs are growing; and the diagnosis is rendered certain if we find the fungus elements and damaged hairs. It is in such instances as these that the parasitic disease assumes the form of lichen pilaris, or tinea pilaris, as I have ventured to style it.

CHAPTER IV.

Special Conditions which determine the Form and Seat of Disease.

(*a.*) *Constitution.*—This has been considered before. Plethoric and robust people are said to be especially liable to sycosis. The lymphatic temperament predisposes to the occurrence of tinea tonsurans, and scrofulous people are affected by tinea favosa. I am fully convinced that there is much truth in these statements.

(*b.*) *Age.*—Children are more liable to *tinea* than adults, for their blood state is that disposed to exhibit *eruption*, and as age advances the two decline in severity *pari passu*. The same holds good in the animal series. Again, the circulation of the scalp in the young is particularly active, the tissues are more delicate, the hairs are rapidly growing, and hence disease is *determined* to this locality. The scalp, however, may be affected at an *advanced age*. Thorough ablution is the rule in children, and their general *surface* being kept clean affords less opportunity for the development of fungi. Again, the absence of the beard, of the pubic hair, and also of hair in many parts of the general surface up to puberty, explains the immunity of the young with regard to certain varieties of tinea. As age increases, eruptions of the scaly kind are frequent, and afford opportunity for the implantation of the parasites. The character of the skin diseases of the adult, contrasting with the moist varieties of the child, indicates a change in the organism at large, exemplified not only in the fact that, *cæteris paribus*, fungi flourish less perfectly, but also that the irritation

produced in turn by the parasite itself is neither so widely nor so decidedly felt. In the young it is extensive and marked, in the adult limited and less severe; hence, also, as age advances the circular form is preserved, because coalescence is less favoured, and the scalp itself becomes tough and less vascular. It has been said by competent authority that the human scalp is rarely, if ever, attacked by ringworm. I have seen many exceptions to this statement, and in all these the eruptive crasis has been pretty clearly evidenced. One of the worst attacks of tinea tonsurans I ever saw, as regards obstinacy of treatment, &c., occurred in a woman aged 43. Another instance of tinea was that in a gentleman aged 41. Tinea circinata I have seen extensively developed in the forearm of a woman aged 87, and in her case eczema is an old standing complaint; besides, in the members of her family impetiginous and other affections are common, and ringworm has been exhibited to a very marked extent.

Mr. Hutchinson gave to the Pathological Society, in 1859, a supposed satisfactory explanation of the immunity of adults in regard to ringworm. He stated "that at or about the age of fifteen, the human scalp ceases to be accessible to the attacks of the fungus of ringworm, and that at or about that age, the epidermis of the epigastrium becomes for the first time a fitting pabulum for that of pityriasis." Again, "that the immunity of adults from ringworm of the scalp, no doubt, was due to the greater hardness of the cortex of the hair in adults than in children." These remarks appear to me *insufficient*. The human scalp, as before observed, does not about the age of fifteen *cease* to be liable to ringworm. Adults are less likely to be attacked by ringworm because they possess, in a less degree, that peculiar condition of nutrition best fitted for parasitic growth; the eruptive or nutritive type has given place to what may be termed organic disease. The greater hardness of the cortex of the hair will scarcely explain their limited liability, for this has little, if any, influence upon the onset of parasitic disease; the fungus makes its way to the follicle; travels

downwards to the papilla, *and gets into the interior of the hair* THROUGH ITS SOFT GROWING *part*, and this can take place with equal facility in the adult and child. The quality of the cortex may possibly influence *the progress* of the disease by the resistance it offers, but how insignificant must this be when opposed to the wonderful force exerted by a growing fungus; indeed, it appears oftentimes as though the hairs of adults were more rapidly broken up on account of their greater brittleness and dryness. The epithelium of the epigastrium is certainly the locality selected, in conjunction with that of the thorax, by adult life for the growth of parasites, as in tinea versicolor, but it can scarcely be said to be liable only after fifteen years of age, and then more than any other part of the body, from its own intrinsic qualities. The concomitant circumstances are more active in favouring the occurrence of chloasma about the age named. The growth of hair begins to be distinct, heat and moisture are increased by the use of flannel, the latter being seldom changed, and more particularly ablution is less frequently practised than at the previous age—people are left to take charge of their own skin, and do not get their regular wash in like manner to children. Mr. Hutchinson's remark would seem to imply that the epithelium of the thorax is not liable to become affected before fifteen, as though some special modification were effected in its intimate nature at that period. The practical point in reference to the influence of age appears to be simply this, that the necessary nidus gradually lessens in intensity; its evidences are less distinctly marked. Hence the scaly replace vesicular and pustular eruptions; hence also parasitic diseases are neither so well marked nor so frequent; the tissues are denser and more resistent, and *in some degree* may counteract the onset and spread of parasitic growth. Further, the local circumstances favourable to the latter, viz., secretion, moisture, &c. are *nil*, or in little amount in the scaly affections of the adult. And lastly, in those cases of adults affected by tinea, we often find symptoms of stomach derangement in the form of dyspepsia, or signs of the non-specific eruptive crasis present.

(*c.*) *Sex.*—Sycosis is rare, of course, in females. It is generally taught that boys are more affected upon the whole than girls. Possibly it may be so, as Bazin declares. but I have seen as many cases in girls as boys, and it is questionable if boys, *per se,* are more likely to become affected than girls; rather is it that the opportunity of contagion is more frequently and commonly exhibited among boys, who, perhaps, make more free use of each other's toilette.

Senile alopecia is rare in females, but tinea decalvans is not; this shows clearly what is a most important fact, that the two kinds of disease, *i.e.* atrophy and tinea decalvans, are totally distinct in character.

(*d.*) *Seat of the disease.*—This has been partly referred to, and it is only necessary to remark here that the amount of hair follicles, perhaps, plays the most important part in determining the form of the tinea patches. Their orifices form the most suitable spots for the development of the spores, and if the dissemination of the germs be free, and the soil very favourable, the separate starting points run together, and the disease extends in an irregular manner; where the circumstances are contrary, the original and circular form is more likely to be preserved, as in tinea circinata and decalvans.

(*e.*) *Hygiene and Social Condition.*—Much which falls under this head has been anticipated. The poor are infinitely more subject to the severer forms than are the higher classes, and the discrepancy finds its ready explanation in the difference of hygiene in the two cases. Especially is cleanliness conservative and prophylactic. With regard to the influence of season, little is known. There is frequently a "run" of cases, which has led some to think that electrical conditions have special aiding power in the development of parasites; but, judging from the history of vegetable disease, it appears much more likely that variations in the atmosphere and the like, which antecede the run of cases, act by rendering the system more disposed to the reception and development of fungi. There is a well-founded belief that intemperate habits have much to do with the aggravation and

protractive cure of sycosis, and the experience of most testifies to the truth of the same. The worst cases I have seen have generally been associated with the taking of full quantities of porter and beer, but it is true also that in some instances no such connexion can be traced. It is said that Jews are apt subjects for favus. Favus, too, is common in Edinburgh, the skin wards there seldom being free from it, if I mistake not. Dr. W. Pirrie (*loc. cit.*) mentions the occurrence of 120 cases in 10 years in Edinburgh, against 15 in 9 years in Glasgow, 24 in 9 years in Aberdeen, and 23 in 4 years to Dr. Neligan. The population of Glasgow being more than double that of Edinburgh, and Aberdeen something less than Glasgow. Now, is the distinguishing characteristic of the diet of the Scotch, to some extent the exclusion of oily, or rather fatty food, particularly marked in the case of the oatmeal diet? There can be no doubt, as will be more fully stated in reference to the treatment, that all fatty and oily substances do help very much the cure of severe tinea; and the idea occurs to one, whether the liability of the Scotch may in any degree be due to the peculiarity above noticed.

CHAPTER V.

The Fungi themselves.—Microscopic Characters.

I. *The Fungi considered generally.*—The vegetable organisms found within or upon the human surface, are either algæ or fungi, and are botanically ranked under the class Cryptogamia. Robin, in his "Histoire Naturelle des Végétaux Parasites qui croissent sur l'Homme et les Animaux Vivans," adopts the division of Leveillé into six divisions—viz., Arthrosporés, Trichosporés, Cystosporés, Clinosporés, Thecasporés, and Basidiosporés. All those met with in man are contained in the Arthrosporés and Clinosporés, and may be represented as follows:—

Arthrospores. *Groups.*	1. Torulacés: simple structure, chiefly composed of spores, or spores and mycelium.	*Genera*	1. Trichophyton.	*Species*	A. Tonsurans.	*Disease* Tinea tonsurans.
					B. Sporuloides.	Tinea Polonica.
					C. Ulcerum.	Ulcer of leg.
			2. Microsporon.	*Species*	A. Mentagrophytes.	*Disease* Tinea sycosis.
					B. Audouini.	Tinea decalvans.
					C. Furfurans.	Tinea versicolor.
	2. Oïdiés: structure—complex spores, mycellium, and receptacles.	*Genera*	1. Achorion.	*Species*	A. Schönleinii.	*Disease* Tinea favosa.
			2. Oïdium.	*Species*	A. Albicans.	*Disease* Aptha.
Clinospores.	Coniopsidés.	*Genus*	Puccinia.	*Species*	d'Arnsten.	*Disease* Tinea favosa. Tinea tarsi. Acne.

English authorities (Berkeley, Lindley) define fungi to be cellular flowerless plants, nourished by their thallus (mycelium), living in air, propagated by spores (colourless or brown, and sometimes enclosed in asci), destitute of green gonidia: they also make six divisions, as follows:—

1. Hymenomycetes, Agaricaceæ, or Toadstools:
   spores generally quaternate on distinct sporophores; hymenium naked.
2. Gasteromycetes, Lycoperdaceæ, or Puff-balls:
   spores generally quaternate on distinct sporophores; hymenium enclosed in a membrane called peridium.
3. Coniomycetes, Uredinaceæ, or Blights:
   spores single, often septate on more or less distinct sporophores; flocci of fruit mere peduncles.
4. Hyphomycetes, Botrytaceæ, or Mildews:
   spores naked, often septate; thallus floccose.
5. Ascomycetes, Helvellaceæ, or Morels:
   sporidia contained in asci; generally eight sporidia.
6. Physomycetes, Mucoraceæ, or Moulds:
   spores surrounded by a vesicular veil, or sporangium; thallus floccose.

Everyone is familiar with examples of the first division. In the second, are such plants as the common puff-ball, or lycoperdon, and the common bovista. In the third, which is analogous to the Clinosporés of Robin and Leveillé, are to be found the corn-mildew, or *puccinia,* the *uredo,* which occurs in the "bunt," "smut-ball," "pepper-brand," and "dust-brand" of corn; the *tubercinia,* in the tuber of the potato, and the æcidium (berberry blight, nettle blight, pear-tree blight). In the fourth, analogous to the Arthrosporés, rank the fungus which attacks the fir and poplar wood, or *graphium;* the *aspergillus,* or common blue mouldiness; the *botrytis,* or potato mildew, muscardine, &c.; the *penicillium,* or vinegar plant; the *oïdium,* or vine mildew, ergot, &c.; and the *lanosa,* which is found beneath the snow, and attacks rye and barley. The fifth category comprises such examples as *sphæria,* which grows upon the surface of caterpillars; *erysiphe,* the fungus attacking peas, maple leaves, &c.; and *onygena,* which springs up in dung. In the sixth division are the mucors, or the mouldiness which is found on paste, fruits, and preserves.

The fungi consist of the following morphological structures. (In the uredines, or coniomycetes, for the most part,

the plants are made up of cells alone; but there is reason to think that these are not independent plants) :—

1. *Spores.*—These are round or oval, having an average size of ·006 mm., solitary, or arranged in rows which are single or many filed, or collected together in groups of varying sizes. The spores often show a dark spot, an actual nucleus, or nuclei, in their interior. They are double contoured, often constricted, and the halves may be unequal or equal in size; if the former, then the smaller cell is regarded as produced by a process of budding.

2. *Chains of the same spores, which have a more or less beaded appearance.*—There is a real union between the component cells, and the rows are moniliform, or multiple, and branch in various directions. These forms usually receive the name of sporidia, or sporule-bearers. Within them are found, clear contents, or granules, or if large, sporules.

3. *Threads of very various shapes and sizes.*—The least expressed form is that of a fine transparent filament, and there are stages between this and the large doubly contoured tubes. The contents are usually granules and cells. The tubes are often not uniform in diameter, being more or less constricted, and the interior space is partitioned by septa. The filaments interlace usually in a very free manner, and bear at their extremities various forms of fructification, either an enlarged terminal solitary cell or a shortly jointed tube, or a clustering of spores, seated upon a receptacle, or a radiate arrangement of spores, &c. These tubes and threads are called thallus-fibrils.

4. *Stroma.*—This consists of an infinite number of minute cells, and is the early condition or nuclear form of the fully developed fungus, accompanies all fungi in a state of active growth, and is oftentimes well seen in tinea favosa. It is worthy of notice, that the nucleated cells exhibit a molecular movement of their contents.

The structure of the spore is very simple. It has an outer coat or envelope composed of cellulose, and an inner one or utricule, enclosing a liquid which contains floating

granules, and is coloured blue by iodine. These spores may be confounded with many other cells. With fat globules, blood discs, corpuscles of various fluids, young epithelial cells, or rather nuclei, pus, and earthy particles. The effect of re-agents will, however, prevent error. The spores are unaffected by ether, chloroform, and spirit of wine, which dissolve fatty cells, and render epithelial tissues transparent. Ammonia renders the spores a little more colourless, perhaps, whilst it dissolves pus and the secretion of many eruptive diseases (which contains small granules and cells somewhat resembling large spores) "converting them into a gelatinous mass." Impetiginous crusts, fat, pus globules, hair, and epithelium are dissolved when heated in a hot solution of potash, especially if a little alcohol is added.

In the germination of fungi care must be taken not to confound earthy particles with sporules—a mistake by no means unlikely to occur. The granular, duplicate, and quaternate forms of "concretions" assumed by carbonate and phosphate of lime resemble to the unpractised eye the analogous appearances presented by fungi; the addition of acids at once destroys the former, and the two conditions, moreover, may be readily distinguished by means of polarized light. The sporules sometimes take on the aspect of animal structures, and it is by no means, as would at first sight appear, an easy matter to discriminate between similitudes of this kind. In Beale's *Archiv*, vol. ii., p. 49, the resemblance of sporules and blood cells is noted, and in vol. i., p. 251, "Vegetable Organisms and Spermatozoa." The stroma may be mistaken for pigment, earthy molecules, and the nuclei of the epithelial tissue, and *vice versâ*.

It seems improbable that the nuclei of the epithelium could be mistaken for the stromal form of fungus—it is not unlikely, however, if the object happen to be rubbed during the process of examination between the two glasses; but the *structures generally* are normal in the one case and diseased in the other (when the storma is present). The greatest care must be taken on every occasion to distinguish between fatty cells and spores and diffused molecular fat and sporules,

or the nuclear form of fungus; indeed, this is the important practical point requiring attention clinically, and really it is a very difficult thing oftentimes to get rid of the fatty matter even by the aid of ether. If we suspect the presence of much fat, it is advisable to allow the hair or other object *to soak for some time* in ether if any doubt exists as to the nature of any particles, cells, or granules. The fat-cells always exhibit a wide variation as regards size, and have a duller, yellowish aspect; the cells of the fungus, on the other hand, are pretty uniform in size in any particular case, refract the light very perfectly (indeed, so does fat), and their outline is more defined and contoured. In old standing cases of tinea, the epithelial cells take on a kind of fatty degeneration, and look very like cells invaded by sporules. When the mycelium is well developed no mistake can well arise, but there are one or two foreign matters and modifications of normal structure that offer appearances similar in aspect to some of the less flourishing examples of mycelial threads. I have known the fibres from handkerchiefs or towels which have been used to cleanse the object-glass to be recognised as mycelial filaments. Sometimes some of the fibres of the hair will be stripped off the shaft and curl back like mycelium. It is of great importance to notice that the imbrication of the epithelium is sometimes irregular, and the edges of the scales present exactly the appearance of mycelium running transversely through and across the shaft of the hair, and it is really difficult to imagine that filaments are not present, more especially if there happen to be a few sporules scattered throughout the interior of the hair. The cause of this irregularity is an interference with the proper and due formation of the epithelial sheath in consequence of the attack of a parasite during the course of tinea, and yet not to such a degree as to check it altogether, or (during the stage of repair) from inactivity of the formative papilla, and when the hair is tolerably transparent. However, by careful observation the outlines of the cells may be traced not only over, but beyond the area of the hair. If it were mycelium it would not run so absolutely

parallel—there would be assuredly some of the fibres running in the direction of the least resistance, viz., longitudinally, and the proper fibrous structure of the hair itself would be separated to some extent. This is probably an error of very common occurrence. The anomalous condition referred to is very much like that figured at p. 82 of Dr. Anderson's work, representing the (spores and) mycelium in a hair from tinea decalvans, after Bazin.

In examining for the fungus, extract a hair from a diseased patch, and place it *at once* in a little diluted liquor potassæ (to render the parts transparent), then drop a piece of thin glass over it, without the use of any pressure, and put it under the microscope. Then if it be necessary to examine more minutely, dissect the parts carefully with a needle. As a rule, harm is done by rubbing or squeezing the preparation between the two glasses. To get rid of the fatty matter, it is best to soak the hair in ether, and then to wash it thoroughly before adding liq. potassæ. With regard to the furfuraceous desquamation, those scales which are situated at the edge of the diseased patch should be selected and treated in like manner without using pressure, and as small an amount as is convenient should be subjected to examination.

The mode of development of the fungus is believed to be as follows:—At first a filament shoots out, "then it acquires several constrictions, assuming a beaded form; and, lastly, as these constrictions deepen, the individual spores are produced." (Hebra: *Allgemeine Wiener Medizinische Zeitung*, 1858, p. 8.)

In the most recent work upon the subject (that of Dr. Anderson), in speaking of the fungus, the author says, "There are numerous tubes, many of them branched, some simple, others jointed, as if originally formed by a number of sporules united together at their ends. This, however, is not the case, for it is the sporules which are formed from the tubes, although these latter are originally derived from the sporules."—(p. 19). This view will be specially referred to in the second part of the subject, when its correctness

will be called in question. The tubes are formed from the spores, but the sporules are never formed from *the actual tubes,* but in them by endogenous formation; and this latter may take place either in the tubes, which are the joined cells, or in the free cells themselves. There are stages linking together the round, the oval, and the tubular conditions, and hinting at their common nature and mode of development.

II. *The Fungi considered individually.*—Most of these are unicellular plants; the algæ and the fungi bear the closest resemblance to one another, and are said to be distinguished from each other by the presence of chlorophyll in the former. This, however, is by no means a sure test, as will presently appear.

For practical purpose, the division of parasites into those of the skin and those of the mucous surfaces is the best. Following this arrangement, *a brief summary* will now be given of each fungus, *according to the general teaching of the present day.*

A. *Parasites found upon the External Surface of the Body, or Epiphytes.*

1. Achorion Schönleinii, Plate I. fig. 1. *Syn.:* Oïdium Schönleinii—Mycoderma of tinea favosa—Porrigophyte (the fungus of tinea favosa). Spores oval, ·003 to ·01 mm., free or conjoined—filaments large branched, containing sporules in their interior—spores join and form filaments. If they germinate, become round and put forth myceloid tubes—there is generally a good deal of stroma present with this fungus—attempts at the formation of capitate heads of fructification sometimes happen.

2. Trichophyton tonsurans, Plate I. fig. 2. *Syn.:* Trichomyces tonsurans—Mycoderma of Plica Polonica—Fungus of herpes tonsurans—Achorion Lebertii—Rhizophyte (the fungus of tinea tonsurans). Round or slightly oval spores, ·003 to ·007 mm. long, and ·003 to ·004 broad, which appear very frequently to have a nucleus, and to be at times constricted—seat chiefly in the interior of the roots of the hairs—the filaments forming the mycelium are

articulated, and to some extent undulated, and contain granules in their interior—spores especially numerous.

3. Trichophyton sporuloides. *Syn.:* Mycoderma of Plica Polonica bears an almost exact resemblance to the last—·002 to ·005 mm.—spores said not to be generally quite so large, but more constantly round, and the articulated filaments always moniliform. According to Von Walther, a very distinct spot is seen in each spore, the fungus is usually mixed up with a large amount of adhesive mucus.

4. Trichophyton ulcerum, found by Robin in an ulcer of the leg; has the same characters as T. tonsurans; bears resemblance also to torula guttata.

5. Microsporon audouini, Plate I. figs. 5 and 6 (the fungus of tinea decalvans). Spores ·001 to ·005 mm.; the general point of distinction is the small size of the spores and the ill-developed character of the mycelium, which is said to be particularly wavy, and devoid of granules in its interior.

6. Microsporon mentagrophytes, Plate I. figs. 3 and 4 (the fungus of tinea sycosis). Spores ·003 to ·004 mm.; round; may be oval, and apparently nucleated; they bear the closest resemblance to T. tonsurans. The mycelial threads are said to be branched at an angle of from 40° to 80°, and to be annulated in this variety; said to have its peculiar seat outside and around the hair. This is erroneous.

7. Microsporon furfur, Plate II. fig. 1 (the fungus of tinea versicolor). Spores average from ·0008 to ·002 mm.; they are round, generally small, and characterized especially by their being grouped together in little round heaps or masses, and seated upon the under surface of the epidermis. The mycelial threads are branched, and have a wavy course.

8. Puccinia, Plate II. fig. 12 (found in tinea favosa, tinea tarsi, tinea versicolor, and acne). It is pear-shaped, and made up of two parts, a body and an extremity; the former consists of two cells of unequal size, which frequently contain sporules; the latter is simply a portion of the jointed tube of the mycelium. The whole is of a brownish colour, and the measurements are as follows (according to Küchenmeis-

ter) : *length* of whole parasite, ·002—348 mm. ; of body alone, ·00415—188 mm. ; *length* of stalk, ·00032—·00160 ; *breadth* of body, ·00056—70 mm. ; breadth of stalk, ·00015—30 mm. ; cellular tissue, ·00008—10 thick.

9. The nail-fungus is either the achorion or the microsporon audouini, which latter has been seen by Bazin attacking the nail. Virchow has noticed the receptacle of the nail-fungus to resemble aspergillus.

10. Mucor (found in gangrene, tuberculous cavities, &c.), consists of spores and a free interlaced mycelium, "with tubular septate threads," bearing at each of their extremities "a round membranous spore case," full of sporules, and which bursts on the addition of fluid, giving exit to the contained cells. The measurements are as follows: length of thallus threads, ·308 mm. ; breadth, ·002 to ·008 mm. ; size of sporangium, ·025 mm., and of the spores, ·0036—·004 mm. in length by ·0015—·0017 in breadth.

11. Aspergillus, Plate IV. fig. 4, Plate III. fig. 3. This has been seen in the human body, in the wax of the ear, and in disease of the nails (?) It consists of a network of tubes, moderately transparent, septate, branched, and consisting of elongated cells of varying length, from ·008 to ·2 mm. in length, and having an average diameter of ·01 mm. Besides these there are certain threads which are terminal and fertile, called *receptacular filaments*. They have a tolerably uniform diameter of about ·009 to ·01 mm., and end in what is called a *capitulum*, of from ·05 to ·15 mm. in length ; it is simply a capitate point, and upon this rests the *receptaculum*, which is of a more or less dark aspect, and upon and around this the *round* spores, ·003 mm. in size, are loosely congregated, often in a radiate disposition. The capitulum is not readily seen. The nature of the fructification will be explained hereafter.

12. Penicillium, Plate IV. fig. 1, not found *on the surface* of man, in the urine, however, mostly of diabetic subjects, is so closely allied to the aspergillus, that a brief description will be useful, as reference will be made to it presently. The fungus is composed of mycelioid threads, which branch

mostly in a duplicate manner; the spores are like those of aspergillus, with this difference, that whereas in the latter instance the fructification consists of spores seated upon a receptacle, in the penicillium they are arranged in pencils or rays, and seated upon or "disposed in patches about the pencil-shaped ends of septate fertile threads."

13. Chionyphe Carteri (found in the Madura foot), Plate IV. fig. 5. This fungus occurs in globular masses, varying in size from that of a pin's head to that of a bullet; it is firm, yet friable, "the external surface being of a deep black colour, and studded with minute tubercles, which give the mass a mulberry appearance when magnified." A section presents a radiated appearance, of a dark aspect, and fracture of the components takes place in the direction of the apparent fibres; the masses are spheroidal or irregular, from being blended together. On minute inspection, they are seen to be made up of tubular structures, which radiate very regularly, branch and join with their neighbours in passing towards the circumference; the fibres are cylindrical in form, and "knotted." At their free ends, sometimes laterally "they bear one or more dark-coloured terminal, globular, and very firm expansions;" they vary in size, but give rise by their projection to the tuberculated appearance of the exterior of the masses. The globular dilatations are $\frac{1}{120}$ in. diameter. The branching fasciculi are homogeneous, mixed up with granules, and frequently exhibit a beaded structure in part of their course, and "such cellular-beaded fibres form the great mass of the globular dilatations." They are to be met with of all sizes, branching "and giving off inflated cells," the diameter of which is $\frac{1}{6000}$ to $\frac{1}{3000}$ inch. The smaller masses are just a packing together of the dilated extremities of the terminal threads, which have become detached, and also numerous oval granular or apparently nucleated spores; the larger bodies appear often as though they had been ruptured. The black granules or masses are found in conjunction with large masses, or by themselves, in some of the deeper seated sinuses, from whence they issue and form a characteristic feature in the discharge. "They are imbedded

in a fleshy mass, presenting, (1) myriads of small cells, oval, compound, dividing; (2) numerous large granule cells (black), others light, round, or irregular; (3) a framework formed by a close network of tubes, crammed in some places with large clear vesicles, or like bloodvessels." There is a second variety, consisting of—1. Separate light-coloured particles, which when magnified are seen to be tuberculated on their exterior, and made up of beaded filaments, similar in appearance to, but smaller than those found in the other variety, and imbedded in a greenish slough-like glairy substance, which is composed of numerous filaments, forming a kind of network in which are seen "much granular matter, oil globules, and granular cells."

2. Simple or compound cells, of a pink or brown hue, with transitional forms running on to the condition of beaded fibres. This, according to Dr. Carter's description, is not so distinctly developed as the other variety, and is surrounded by a good quantity of crystalline matter. The real difference between the two would seem to be in the colour, the one being dark and the other light. Besides these elements described, Dr. Carter calls attention to and figures a quaternate arrangement of spores in the dark variety, produced apparently by the duplicate sub-division of a parent cell, and this observation is extremely interesting in relation to the nature and source of sarcina. Of course, in the absence of further observation, any attempt to explain dubious points can only be unsatisfactory, future research will have to decide how far the difference in colour when examined by the microscope, and even by the naked eye, is due to the peculiar packing together of, and the consequent modification of the action of light upon, the component elements in the two cases. This explanation may be exemplified in the most convincing manner in the case of aspergillus. The dark colour may also be in part due to pigmentary changes, or the action of fœtid discharge upon the effused hæmatin of the blood. Dr. Carter shows that the germs must be introduced from without, that it is a local disease, that it does not attack several, or more than one in a family, and that it frequently follows slight wounds. Some

think it peculiar to the cotton districts. In the *Madras Quarterly Journal* for April, 1862, are some observations upon the same subject from the pen of Dr. Bidie, and his remarks are in unison with those of Dr. Carter; but he adds that the fungus belongs to the class arthrosporei and is very like the tribe oïdiei. I have carefully examined the plates of Dr. Carter, and was struck with the great resemblance which his fungus bore to the torula and oïdium.

Mr. Berkeley has very recently analysed the question of the fungus foot of India in the *Intellectual Observer* for November, 1862; so far as concerns the vegetable structure found in it. He describes several forms.

1. Typical, accompanied by pink stains on the skin, with channels filled with spherical ovate groups of minute bright orange-coloured particles, the structure of the truffle-like bodies presents exactly the characters of a true oïdium. "Short beaded tawny threads arise from a common base, consisting of cylindrical articulated filaments, having at their tips large spore-like cells;" these burst, and nothing remains but the fragment of cells, and the artificial germination gives rise to "a perfect mould." The fungus resembles closely the genus mucor, but there is no columella in the sporangium, a character which accords with chionyphe rather than with mucor; indeed, Mr. Berkeley does not see a single character in which it differs from chionyphe, and he gives it the name of Chionyphe Carteri.

2nd form.—In this the black masses are wanting; but what looks like sloughing tissue is present, with little white granules, made of large cells filled with smaller ones (brood cells) and towards the circumference moniliform threads.

3rd form.—Here there are opaque bodies, consisting of mother filled with daughter cells, "clothed externally with a radiating growth assuming a variety of forms." "The structure so exactly simulates that of minute moulds, that it is difficult to get rid of the notion that they are really vegetable growths." There would appear to be, then, two distinct structures, the one the fungus in its various forms, and something additional, which may exhibit the following appearances:—

(1) Straight slender threads radiating in every direction, each of which is surrounded by an elliptic sporelike body; or (2) a regular globe; or (3) a shortened stem and an irregular globe; (4) globes may be absent, and the fundamental cell bud like aspergillus (receptacle); (5) dicotomous or trichotomous fascicles of linear crystals which are free above; or (6) a dichotomous ending with apparently ciliated extremities; (7) occasionally the termination is lobed; (8) sometimes straight radiating threads are surmounted by a globular head, fringed round at its base with cilia after the manner of volutella; (9) another form is that of little feather-like expansions; and (10) leaf-like, oblong, strongly acuminate scales, simulating the leaves of mosses.

The foundation is, however, in every case an organized cell, the red colour of whose daughter cells is precisely that of the oïdioid threads of the black fungus. Mr. Berkeley expresses no decided opinion as to the nature of those elements which he styles crystals, and which so closely resemble vegetable moulds. From what I have seen of the germination of fungi, they would appear to be different forms of crystallized fat; at any rate, if not all, at least the majority of them, are. It must be remembered that the elements of the chionyphe are very closely surrounded by stearine derived from the changes going on in the diseased tissues around. I have seen several of the above forms produced in the germination of trichophyton tonsurans. Mr. Berkeley thinks the chionyphe may take origin from the mucors.

B. *Parasites of the Mucous Surfaces, or Entophytes.* These are of less interest than the former.

1. Torula, Plate II. fig. 15. *Syn.:* Cryptococcus cerevisiæ; the yeast plant, found in the œsophagus, stomach, intestines, fæces, vomit, bladder, urine, mouth in typhus, cancer, phthisis, hectic of all kinds, loose stools of sucking children (Wedl). As generally seen, it consists of spherical or oval, solitary or joined, nucleated or non-nucleated, transparent cells, from ·007 to ·003 mm., increasing by the formation of buds, which grow to the condition of the parent cells. Yeast, the typical example of torula, is usually described as

consisting of two parts, the one found on the surface and that at the lower parts of the liquid in which it occurs. The cells of the former are oval, the latter are spherical, and present two different types, the one with thin walls, transparent, containing two to ten nuclei, found at the bottom of old yeast; and the other, thick walled, and containing instead of nuclei a granular mass which becomes converted into nuclei as the cells age. When the yeast develops, the thin nucleated cells burst and discharge their nuclei, which become like the thick walled cells; these latter exhibit budding in profusion.

2. Sarcina, Plate I. fig. 10. *Syn.:* Sarcina Goodsirii—Merismopædia ventriculi. Aggregations of quaternate spores, which arrange themselves in irregular, cubical, prismatical, or longitudinal masses (composed of generally from eight to sixty-four cells); the largest of these is from ·055—30 long, by ·02—16mm. broad; they are consistent though elastic, heavier than water, and consequently are found at the bottom of fluids in which they occur. When pressed between two pieces of glass they have a gritty character; they are coloured yellow by iodine, and the cells are joined together by a sort of intercellular "mucilage," which swells up on the addition of liq. potassæ. These little masses are called gonidia. The individual cells measure about ·008—10 mm., and are divided by transverse lines into four parts. Their corners are somewhat rounded off, and their edges are sinuous (this is seen best with a high power); they contain granules or nuclei of about ·0002—4 mm. with nucleoli, and are multiplied, according to general observation, by "duplicate subdivision in directions transversely to each other." Sarcina is frequently associated with the cells of torula and penicillium.

3. Oïdium albicans, Plate II. fig. 1 A. *Syn.:* Aphtophyte; fungus of diphtheria and thrush, "found in the mouth after it has been wide open during prolonged sleep," and its occurrence is favoured by an acid condition of secretions and "catarrh;" it is often seen around the nipples of nurses, and is not uncommon in dyspepsia; has been noticed in ulcers of the extremities by Rayer and others. The plant is made up of cells and mycelial filaments. The cells are

round or elliptical, transparent and homogeneous, about ·003 to ·006 mm.; a good many contain nuclei; they may be free, or what is more common, grouped together in little heaps, or they may form a beaded tube by their junction, in which case they approach the ordinary condition of torula. Some of them appear to bud. These cells by their junction and growth gradually come to assume the character of fibres, of which there is a large diversity. Many are simply pale homogeneous threads, others are larger, more or less branched, and partitioned with well defined parallel edges: these are about ·05 to ·6 mm. long, ·003—5 mm. broad. The largest are oftentimes very slightly branched, and then in a forked manner. All these forms contain a greater or less number of granules or sporules, which are frequently seen most distinctly on either side of and close to the partitions. In the more advanced conditions, the filaments terminate in jointed cells with a large terminal head, or by a series of articulated cells about ·002 mm. long, which decrease in both directions, until a small cell remains as the termination. The mycelial threads interlace very freely, have an average size of about ·006 mm., and their sides are peculiarly parallel. Transitional forms exist between the free cells and the perfect tubes.

4. Leptothrix buccalis. *Syn.:* Alga of the mouth, consists of very fine transparent, homogeneous filaments, transversely divided by partitions, mostly bent and of various lengths, very rarely branched. They are about ·0008 mm. broad, by from ·02 to ·1 mm. long. The fibres are embedded, or arise out of a mass which is composed of very minute granules, and in some instances, at the joints of the tubes, small sporules are visible. A fungus having all the characters of leptothrix has been noticed by Robin in the stools of typhus patients, and by Scanzoni, Donné and others in the vaginal mucus. In the *British and Foreign Med.-Chir. Rev.* for Oct. 62, p. 551, reference is made to a paper "On the Vegetable parasites of the female genital organs in their relation to practice," by Dr. L. Mayer, published in the *Monatsschr. f. Geburtsk,* July 1862. Dr. Mayer detected a fungus on six different occasions. Its seats are the inner

surfaces of the labia, the nymphæ, clitoris, and vagina. A spot appears, about the size of a pin's head, of a bright yellow colour, which is round or irregular, loosely attached to the parts, and on removal an ulcer is discovered. There is some congestion around the diseased spot; the secretion of the parts becomes milky, creamy, &c., and itching and burning are the most troublesome symptoms. The health is often out of order. Dr. Mayer styles the disease *vaginal mycosis*. This is not a very uncommon condition, and may be considered analogous to the apthous condition which occurs within the mouth. The oïdium and leptothrix are the two fungi met with.

5. The group comprised under the term Leptomitus. *Vide* Plate III. fig. 1 B and fig. 2 A.

(*a*.) Leptomitus urophilus, found in the urine.

(*b*.) Leptomitus Hannoveri, occurring in the œsophagus and stomach, and discovered by Hannover there; by Robin in typhus; and by Fuchs in bronchitis. I have myself seen it germinate in sour fluid vomited from the stomach containing the spores of penicillium.

(*c*.) Leptomitus uteri. (*d*.) Leptomitus oculi. Of these two latter, the former is figured by Dr. Wilkinson, in the *Lancet* of 1849, p. 449, and styled Lorum uteri, on account of the peculiar arrangement of some of the secondary filaments, which are disposed like a lash or thong.

(*e*.) Leptomitus found by Gubler in the epidermis in a case of a gunshot wound of the arm.

All these forms have appearances in common. In unison with Robin, the genus may be described as consisting of hemispherical gelatinous tufts, about two or three millimetres in height, the principal fibres of which radiate in all directions from a central spot, and measure about ·0075 mm. in thickness; they are transparent and freely branched. The branchlets are about ·0030 mm. in breadth, diminish in size towards the point, and each ends in a single articulation. The joints vary in length, and show in their centre a round pellucid spot, like a drop of oil. There are several modifications, the characteristic feature, however, is the existence of

an enlarged ovoid cell, mostly terminal with a little projecting joint at the apex, and containing more or less nuclei, the whole resembling very much a club. The small projecting articulating cell may grow, and break up, as it were, by a process of budding, into several filaments, like a thong or lash. The component secondary and tertiary tubes may be uniform or made up of large jointed and elongated cells (sporangia?).

6. The fungi found in glanders, in the lung (called Bennett's), on the pleura (Rayer and Gairdner), in the expectoration of phthisis (Remak), will be referred to presently. They are probably all modifications of oïdium.

7. Various cellular vegetable structures have been found in cholera by Busk, Baly, Gull, Brittan, and Swayne. It appears that these are either a species of uredo, or else torula; besides these there are portions of vegetable membrane (probably from wheat grains), and starch granules, which together constitute the "cholera bodies."

In the *Madras Quarterly Journal* for April 1, 1862, is the account of a fungus discovered by Mr. Lowe in diabetic urine, and it bears the following characters: "Mycelium plumose and of a fawn colour, from which the delicate little stipes sprang in an *umbellate* form, each stipe bearing a black-looking pileus." When magnified as exhibited in a drawing given by Mr. Lowe,

"1. Each stipe was long and filled with numerous spheres and granules varying in colour. The granules passed up the delicate tubes to the pilei.

2. Each pileus was very large and of beautiful purpurine colour. The sporules at the circumference very refractive.

3. The spores were packed in dense masses, and were round, and completely surrounded the extremity of each stipe." Mr. Lowe thinks its colour distinctive. Otherwise, its resemblance to the fungus described by Robin as occurring in the ear is decided. According to my own observations, it is an early condition of aspergillus, at least an incomplete fructification of aspergillus, the colour being produced by the action of light upon the cells, surrounded by air (or gas.)

CHAPTER VI.

Summary of the Microscopical Appearances presented by the Lesions arising from the Growth of Fungi.

These have as yet been merely hinted at. Before proceeding to detail, it may be well to refer to some unusual occurrences met with in the course of my examinations, which have been carried on over a tolerably wide field, and for a considerable time past with great care. In the first place, I have on two separate occasions seen *torula* sprouting from the side of the hair at the bottom of the follicular part in tinea tonsurans. According to Küchenmeister, Hannover confounds achorion with the cryptococcus cerevisiæ (torula), but it is not at all unlikely that Hannover was correct in his description. Modern microscopists have lately used the two terms as synonymous, simply from the apparently identical appearances presented by the achorion in some instances and torula. In the second place, in hunting about between the epithelial lining of the hair in severe tinea tonsurans, where the spores were plentiful, I have observed some largish oval spores (achorion?), accompanied by quaternate bodies, in number about five or six, and not uncommonly two or three spores joined together, which, on the addition of liq. potassæ have swollen up, and thus lost in great measure their distinctness as separate cells. The quaternate arrangements in the present instance had really the appearance of sarcinæ; they were smallish, and their angles were rounded off perhaps somewhat more than usual. Mr. Berkeley (*Gardeners' Chronicle*, August 29, 1857) inferred that sarcina was a form of penicillium or aspergillus, and Dr. Lowe has observed that

there is no reason to doubt the accuracy of my observation, because it is in unison with, and confirmatory of, the expressed opinion of so eminent a mycologist as Mr. Berkeley, of which I confess to have been unaware until my attention was called thereto by Dr. Lowe. In the third place, in regard to abnormal or rather unusual conditions of mycelium, I am certain that not unfrequently appearances may be presented closely similar to if not identical with puccinia. I have never been able to establish its existence, as a distinct fungus, though I have seen several productions closely resembling the usual descriptions of puccinia.

1. The mycelium, when well developed, sometimes seems to increase in breadth at the expense of the length, so to speak, and becomes very short, jointed, and broad.

2. Another condition like it is a partial or actual formation of a clavate head—an early state of fructification. This I have seen in sycosis.

3. The young epithelial cells at the bottom of the follicle, when the process of repair is in activity, are apt to be mistaken for it. In the above instances, there is a general absence of the usual brownish tint of puccinia.

4. Dr. Lowe has also failed to find puccinia, but has noticed a condition of growing spore resembling it, and believes the fungus in question to be "a true reproductive spore formed in the saccule of the mycelium (an ascus)." I have seen the same condition produced in the artificial germination of the achorion, by the junction and enlargement of spores, as in the instance noted by Dr. Lowe.

Under the head of Sarcina, the nature and source of puccinia will be discussed.

Parasites making their way along the epithelial stratum towards the bottom of the hair follicle, come into relation with the hair on the inside, the follicular lining or capsule on the outside, and the bulb and pigment layer below, all of which are more or less invaded and modified. Now the changes or lesions may be arranged under the following heads:—

1. Those in the hairs, epithelium, and nails.
2. Those of the general surface.

3. Those in the pigment formation.
4. Those of the follicles.
5. Those of the glands.

It is scarcely necessary to argue that the fungus elements are not produced by a transformation of the normal structures of any part, which is implied in the teaching of some authorities.

1. *Alteration in the Hairs.*—This is observed in every variety. The hair is formed from the vascular papilla at the bottom of the follicle. (It is important to keep this *prominently* in mind *always* in estimating the cause of the alteration of the hairs, since it is an easy matter to have attention drawn away to the appearances and changes going on at the orifice of the follicle and the surface of diseased patches when enforcing treatment.) It is at this spot that the young delicate cells are being produced and developing into the fibres of the hair on the one hand and the epithelial tissue on the other, though it must be confessed that actual observation seems to indicate beyond a doubt that the former result from a fibrillation of the "periplast;" now these young cells, with the conjoined intercellular substance, moisture, and heat, form a most favourable nidus for the attack of a parasite, which always makes its way towards the vascular papilla, as its selective seat—selective, because affording the very best conditions for the abnormal growth. Having reached the formative apparatus, the fungus, if it finds a suitable pabulum and remains undisturbed, inflicts more or less damage, and so interferes with the formation of the hair, leading to atrophy or total loss. In the instances of medium invasion, the hair continues to grow, and carries up with it the fungus, either adherent to its exterior, or embedded in its interior. According to the amount of irritation exerted by the fungus upon the papilla so is the formation of hair and epithelium affected; in the early stage, there is simply congestion, alteration of colour, retention by secretion, and variation of shape; in the later stages loss of colour, atrophy, alopecia; and to these changes reference must be made more in detail.

Bazin makes a division of parasitic diseases into Tricho-

phytes, Onychiophytes, Epitheliophytes, &c.; according to the part attacked; this division appears to me of no practical value, nay, rather confusing, since hairs, nails, and epithelium are mere modifications of one structure, and more or less (except the nails) affected in every kind of tinea. The changes in the hair affect its shape, colour, amount, and consistence, and are most marked in favus, least in chloasma and tinea decalvans. The first effect of the growth of fungus is to increase the formation of epithelium in the follicle. This presses upon the shaft of the hair, and not uncommonly retards its elongation, and thus becomes one cause of the enlargement of the bulbs. At an early period the roots are healthy, the bulbs long, and curled when pulled out; and at the same time, in consequence of the detention of the hair, congestion of the papilla would seem to ensue, pigment to be deposited in diffused granules throughout the bulb in more than normal amount, and the hair to be rather darker than usual. This is an early stage, and an exceptional condition. The fungus is found in the epithelium on the shaft, and this condition is not unlikely to be mistaken for disease within the hair itself. The fungus now gets deeper into the follicle, accompanied by an increased production of epithelial cells, which adhere to, and press upon the shaft of the hair more effectively. The follicular sheath is damaged, and when the fungus reaches the papilla, the hair, if pulled out, comes away minus its usual capsules, the fenestrated membrane disappears, the epithelial lining is replaced by an irregular mass of "blastema" and cells loaded with spores, the pigment formation is interrupted, the hair becomes dry, brittle, pale, and easily comes out, and its bulb is ill-formed. From this it follows that in the early stage the change of shape is seen in the bulb more particularly, and is due to the pressure exerted upon the hair, and its subsequent retention.

When, however, the disease has existed sufficiently long to enable the fungus to get into its interior, the hair may be altered very variously; this never occurs, perhaps, certainly to any marked extent, before the fungus has reached

the papilla and ascended with the growing parts; in other words, the parasite does not get into the shaft of the hair in any part of its course (except in cases where the hair has been shaved); the cortical part appears to resist the entrance of a fungus; it would be more correct to say, perhaps, that the fungus is attracted in its growth towards the bottom of the follicle, where its invasion of the hair is easily accomplished, almost of necessity. The enlargement of the hair may be general or local; in severe cases of disease, it is mostly general, in the slighter forms local, producing decided bulgings; the latter are particularly well marked in the later stages, in the little dark stubs that are frequently observed, for these have been detained for some time in the follicle, and the spores have developed to a full degree, so as to affect the diameter of the hair considerably, and in an unequal manner where the collections of germs were originally most extensive. In favus, and tinea tonsurans, the diffusion of parasitic elements is tolerably uniform; in tinea decalvans, tinea circinata, and the like it is irregular; hence this circumstance is chiefly instrumental in producing bulging in the shaft of the hair. It may certainly be due, however, to extrinsic pressure. In examining the hairs in tinea, it is usual to find them bent more or less at an obtuse angle; this may be due to several causes:—

1. To mere plugging up of the follicle by secretion and detention of the upper part of the shaft, whilst the growth still goes on at the papilla; in some instances, half an inch or so may be drawn out from beneath a kind of false operculum.

2. There may be nothing of the kind to explain it; then it is usually due to the presence of mycelium in the follicle, which clings to the hair on one side and the follicle on the other, blocks up the passage, and holds the hair (whilst it continues forming) to the diseased spot.

3. It may be due to the mere pulling out.

4. Most commonly it is due to the local infiltration of the bent part by the fungus.

5. It is an exceptional thing, on examining the bent por-

tion, to observe a piece of mycelium stretching across it, and on the addition of liq. potassæ, the filaments loosen, the hairs swell up, start back into a perfectly straight position, and present a completely healthy appearance; this condition is evidently very much favoured by the want of moisture which characterizes many cases of tinea.

The *bulb* of the hair deviates from its normal shape according to the stage of the disease, and the amount of injury done to the formative papilla, when it is either shortened, of small size generally, or even comparatively speaking wanting; under these circumstances, the whole substance of the shaft above is split up by the fungus, its fibres separated, and little loculi formed by the disposition, in many cases, of little heaps of spores and sporules among the component structures. Whenever there is a lack of moisture the hairs are more brittle; this probably explains in part the character of the hairs in tinea decalvans and tinea tonsurans, as compared with those of tinea favosa, in which secretion is plentiful.

An important condition is generally overlooked, viz., the presence of amorphous stroma which accompanies almost all cases of tinea, and which is a marked feature in favus and tinea tonsurans, infiltrating all parts, and giving rise to more or less bulging, diffused swelling, and so on. I have hinted before that this may be the only evidence of the presence of a fungus, and that I have been able to produce by a slow process of germination true sporules out of it. Now in some cases on the addition of liq. potassæ, and allowing a little time to elapse, this stroma is observed to be made up of very minute sporules closely packed together; and on one or two occasions when the granular appearance in the hair was very distinct, I have noticed the contents swell up on the addition of alkali, the cortical part give way, and a regular discharge of minute spores take place (there are transitional states between the nuclear and the sporular form). The stroma bears the closest resemblance to pigment infiltration, and the two may be easily confounded. They are distinguishable as follows:—

Abnormal pigment deposit as the rule does not occur in the early stage, but during the period of convalescence.	1.	Stroma infiltration occurs at the outset and at the height of disease.
Is less refractive.	2.	Is more refractive.
More evenly disseminated.	3.	More in the form of local deposits.
Shaft of hair equal in calibre.	4.	Shaft of hair unequal; presents little bulgings corresponding to local deposits.
Absence of fungus elements.	5.	Presence of other elements of fungus.
Hair not abnormally surrounded by epithelium, imbrication nil, or if present, pretty natural.	6.	Shaft surrounded by masses of epithelium, imbrication less perfect, irregular.
Bulb reforming or well formed.	7.	Bulb ill formed.

Changes in Colour.—One of the usual effects of the ravages of a parasite is an alteration of the usual tint of the hairs to a dull and dark aspect, due in part to the absence of the usual sebaceous matter, and also to alteration in the amount of pigment deposit consequent upon interference with the functions of the papilla. When these are in abeyance, practically speaking, the formation and deposit of pigment is at an end, and its deficiency is observed in conjunction with tapering, atrophied, bulbless roots, and the absence of the root-sheath. Any cause which favours an increased flow of blood to the formative papilla, will (provided the hair be retained and continue to grow in the follicle) increase materially the deposit of pigment. When viewed under the microscope, the hairs are sometimes quite black, and very feebly penetrated by light; if they are broken up into small fragments and liq. potassæ added, no cellular structure can be made out, but excessive pigmentation, which *may* take place, not in a *diffused*, which is the rule, but in a *localized* manner. Atrophy and pale colour go together. Those hairs which are the seat of pigment deposit are generally furnished with more or less perfect roots. In severe cases of favus and tinea tonsurans, little black stubs stud the surface in varying proportion, and at first sight look under the microscope as though filled with pigment. However, on closer examination, the dark aspect is shown to be due to the hair being literally crammed full of spores, but this condition in varying degree may be of course complicated by pigment infiltration. It has appeared to me that a very

distinct and practical guide may be obtained from these facts, and it is this, that in the course of severe disease whenever the elements of the fungus are lessening in amount, and pigment deposit taking place to a marked extent, the formative papilla is recovering its activity. This becomes of value in long-standing cases of disease in which atrophy of the hair bulbs is a marked feature. At the very outset, sometimes, the hairs become darker in colour, it would appear in consequence of the congestion of the papilla. This, however, is generally passed when the case comes under observation, but can be traced to some extent at the extending edge of disease. Much more of a theoretical character might be added in reference to this subject; the practical point worth remembrance is just this:—to avoid the confusion of pigment and stroma, for in the instance of the existence of the former a stimulating plan of treatment is demanded, and in the case of stroma the application of parasiticides or the removal of the hairs; in a word, pigment formation means, even in conjunction with a flourishing state of parasite, that the formative papilla of the follicle is only in part damaged and in a state of irritation; if the fungus be absent and the disease that in a late stage, the proper functions of the follicle are being resumed.

Alteration in the Amount of Hair.—Loss of hair, the thing to be prevented, and designated by the term "alopecia," is the cardinal effect of any and all the tineæ. Scarcely anything can be added under this head that is not a repetition of much already stated, still a few remarks are needed for the sake of completeness. The alopecia of old age has none of the characters of parasitic alopecia; it is general, not localized; it is not accompanied, followed by, nor engrafted upon, eruptive manifestations; the scalp of old age is thin throughout, and its follicles are indistinct. Not so, however, is the scalp in which tinea occurs.

Loss of hair independently of old age is not uncommon, and results from the action of depressing causes of all kind: its extent, however, is never great. In cases of fever, the

hair falls off only to be renewed again, in as good a condition as ever. There is one feature which characterizes all these instances—viz., the uniformity of its occurrence over the entire scalp; it is a general loss, or, what is more common, a general thinning. But there are other instances in people out of health, in which the hair comes out unequally, markedly more so in the front or side of the scalp than elsewhere, or perhaps only here and there; the skin of the head may present a healthy look, or, what is more common, it may be affected with pityriasis to a greater or less degree, but I am quite convinced, at the same time, that the very great majority of cases of pityriasis have nothing whatever to do with fungi. The class in which the latter play any part is such as I have defined as affecting the scalp unequally. I have seen this condition affect the husband and wife together, the former being also the subject of "herpes circinatus." The disease of the scalp was not tinea decalvans, at least it was not made up of circular, smooth bald patches, but of irregular ones, covered over with "dandriff." The fungus is very difficult to find, and is best observed in the loose hairs of the extending edge. The hairs are very dry in these cases. Loss of hair is the most extensive in favus and tinea tonsurans. It is highly important to have regard to the fact, which has a most practical application, that no eruptive disease (non-parasitic) ever produces localized alopecia, nor indeed alopecia in any sense. The tumefaction and inflammation of the scalp may damage to some extent the follicles, and thus *check* the growth of the hair generally, but never, so far as I know, to a distinct degree.

In favus, the formative papilla is very seriously damaged, and loss of hair is more acute and more extensive; in tinea tonsurans, the follicle retains the hair tolerably long, and the fungus has plenty of time to get thoroughly into the whole shaft of the hair before alopecia results: here is one cause of the brittleness of the hairs in the latter, though this is due in part to the absence of moisture, such as is present in the case of favus. In the lesser forms of tinea, the fungus is scarcely in sufficient amount to affect the hair so as to render

it (bent and) brittle, except it be from the entwining of mycelium about it.

The following notes of cases are adduced in illustration of the foregoing, and some additional points:—

Case 1. 1859.—Examination of the young hairs springing up after an attack of tinea tonsurans, the patient two years since having had the latter in a very severe form, followed by large bald patches exactly resembling tinea decalvans, the father being affected by sycosis menti:

At first sight the patches appear devoid of hair, but close examination discloses the presence of small downy hairs all over them. They are bright and glistening, very thin and minute, the scalp is slightly puffy, shining, and the hair follicles are distinctly seen. Some of the young hairs come out with difficulty; here and there is a well-formed black hair, towards the circumference especially. The old hairs at the edges exhibit under the microscope various degrees of atrophy; some are well formed, those that taper towards the bulb are looser in texture and split up in places, with a good deal of adherent epithelium about them. In some of the worst, distinct spores are visible, the whole gives the impression that a parasite has been at work, though at this time it has "died out." The young hairs form a transition from the faintest attempt at the formation of a shaft, a pale, homogeneous line, to a tolerably well-formed hair. In the latter the length of the follicular part is short; in the intermediate stages the fibrillation is well seen, on account of the loose packing together of the constituents; pigment is visibly diffused for the first time in the medium stages. This case yielded to the application of iodine, and free stimulation. The patch was the size of the palm of the hand, and coming under observation for the first time would have been diagnosed tinea decalvans, but two years before the case was under care as one among several others of a family affected with severe tinea tonsurans, and it represents very markedly the relation and transition between tinea tonsurans and tinea decalvans.

Case 2. 1860.—A boy about nine years old, with diseased

patches of the scalp. The hairs are apparently healthy, except at base, where they are ill-formed, with adherent epithelium in excessive amount all along the shaft; a good deal of "blastema" also; the hair seems unable to grow on account of the follicle being choked up, as it were; has been under treatment for tinea tonsurans; no fungus can be detected now; plenty of pigment present in the hairs. Soothing treatment recommended; probably irritants have been too long applied. The case shows how necessary it is to make free use of the microscope in all cases in the treatment of tinea. This case soon recovered.

Case 3. The subject of carbuncles on hip, loins, and neck; boils of thigh and legs. Sycosis. Has eczema (chronic) symmetrical, on both thighs, and the inner surface of the knees; the patches situated at the knee are about the size of the palm of the hand, covered with eczematous crusts and micaceous scales; the edges are well defined, the colour is dull red, not quite coppery, and in places they seemed to be composed of little points, which are seen to be seated at the hair follicles. On the right side the disease is the worst; on the left thigh are two spots the size of a shilling, circular, and with defined edges, presenting papulæ here and there with whitish scales; the central part has the appearance of what is called lichen pilaris (of a mild form). The sycosis is now well. On microscopic examination the hairs of the patches on the knees are very dry, shrivelled, with atrophied roots, which are curled back, and seem to be bound in that position by mycelium, which sprouts from the sides and roots of many of the hairs; a few sporules are visible. On the addition of liq. potassæ the curled roots start back into a straight position. Some hairs are healthy, a few only invaded by the fungus, and a quantity of epithelium is observed all round their shafts. Some hairs are split up and present bulgings, where the mycelium is found. This was a case in which the parasitic disease was symmetrical, almost of necessity, through the contact of the two knees. I believe the eczema was not consecutive to parasitic growth, but the result of constitutional causes, the implantation of the fungus being an after occurrence. Now the

exhibition of such remedies as arsenic might no doubt effect a cure, by altering the character of the soil, and so cause the fungus to perish; at the same time, the cure is expedited in such a case when the local cause of irritation (the parasite) is found out and attacked with parasiticides. In the case in point, tincture of iodine was used locally, and gave great help to the internal exhibition of arsenic. Pruritus was exceedingly troublesome, especially when the patient got warm in bed.

Changes in the epidermis or epithelium of the surface and of the follicle, as regards quantity and quality.—The epithelial cells are invariably increased in amount over the general surface of disease, but form only a part of the foreign material present, the larger share in pityriasis, and the lesser in the cup of favus. The secretions of vesicles, pustules, and the remnants of papules must not be omitted from our estimation.

The imbrication of the hair marked at the outset by an excess of layers, soon becomes, as a matter of course, irregular; there is usually a collection of epithelial scales around the openings of the hair-follicles and the shaft of the hair, at varying distances from the follicle, mixed up with mycelium, and at times sporules. The imbrication, as before observed, when irregular, may easily be mistaken for mycelium, and *vice versâ*. Generally speaking, the addition of liq. potassæ suffices, by swelling up the hair and its contents, to detach or disarrange the mycelium, so as to exhibit it free from the hair. It is in the follicular portion that this deception occurs. Be the hairs ever so atrophied, be the scalp ever so smooth and dry, if any irritation exist (either parasitic or from the too free use of irritants), epithelial masses will be detected adherent to the hair at some part of its follicular portion; this adhesion appears to be due to the effusion of "blastema," which agglutinates the parts together, and the condition becomes, in the treatment of the late stages of tinea, of very great importance in a therapeutical sense. When parasitic diseases are severe, the epithelial cells become ill-formed and ill-developed, and

perhaps replaced by a homogeneous mass of yellowish colour, apparently made up in part of ill-formed cells, mixed with broken pieces of diseased hairs, fat, sebaceous matter, and fungus. In cases which have arrived at the turning point of arrest and recovery, it is by no means uncommon to see a little mass of epithelial cells around the hair, just at the commencement of the bulb, which is at its first portion tolerably well formed, but at the last formed part narrow, tapering, and pale. This, which perhaps is the practical point arising from an examination of the condition of the epithelial lining of the follicle, should always excite suspicion; for in a good many cases, if the hair and its adherent epithelial mass be soaked in liq. potassæ for some time, the spores of the parasite which has sprung up anew may be readily detected. In the later stages, when the follicle is returning to its healthy condition, the lining membrane recovers itself, and the epithelial layer can be traced developing normally as a stratum of pale, ovoid, delicate cells, sprouting from the bottom around the hair (they do not exhibit as a rule a nucleus very distinctly).

The epithelial cells may undergo a modification as to quality. I have never seen pus corpuscles mixed up with them, except in cases of inflammation produced by the application of parasiticides; they may take on a fatty change, which must be carefully distinguished from a somewhat similar appearance produced by the invasion of the cells by the sporules of a fungus. The fatty infiltration is found to take place in the severe and obstinate forms of tinea. Pigmentary changes in the epithelium I have not observed. The chief disease of the epithelial cells, is the presence of the fungus elements. In tinea versicolor it is most marked, and said to be absolutely characteristic, inasmuch as the sporules are seated peculiarly at the under surface of the cells. Fatty degeneration *may* possibly be more common and marked in persons of good age, and in scrofulous subjects; it is a condition which requires to be appreciated in the chronic skin diseases, in order that it may not mislead as regards treatment, on account of the supposed presence of

the sporules of a parasite. With regard to the scalp, a few words will suffice. In the early stage, either as a result of the parasitic growth or the application of parasiticides, it may be tender, erythematous, or œdematous; if the fungus is undiminished in amount, it should make little difference in the treatment; if, on the other hand, the parasitic elements are decreasing in quantity, a soothing plan, at all events for a time, should be had recourse to. After severe forms of tineæ the scalp becomes thinned, scarred, and at last white, tough, shining, and dry, little sensible to the action of remedies, and this latter should be borne in mind, for blistering applications, which in the earlier stages would increase materially the irritation, and do other damage, now act often most beneficially as stimulants.

Follicles.—These become more or less obliterated according to the severity, the kind, and the duration of the disease. It is questionable, however, whether they are ever so thoroughly damaged as to annihilate all hope of restoring, at least some of their proper functions. In nine cases out of ten the follicles are scarcely at fault, but rather the formative apparatus of the hair; the obliteration of the follicle in tinea differs from that of old age, in being local and circumscribed in extent, in not affecting the vertex of the head at the outset peculiarly; in the concomitances, *i.e.* of a scalp which has a good circulation, and is well supplied with subcutaneous fat, in the change of hair being sudden, comparatively speaking, and not preceded by greyness. In old age the change is irrecoverable, but in the other instance, the loss of function is remediable.

The lining membrane is the part most affected, and this it will be remembered consists of two coats, an outer called corium, and an inner or epidermic.

1. The corium consists of three layers:—
   - *a.* Areolar, the more external, which is strong, "determines" the peculiar form of the follicle, and is supplied with vessels and nerves.
   - *b.* A layer of circular fibres, the nature of which is at present uncertain.
   - *c.* Basement membrane.

2. The epidermic layer, called the root sheath, is also made up of three strata.

a. Outer (Malpighian layer) consisting of simple cells.

b. Fenestrated membrane.

c. An inner layer of delicate epithelial cells.

The differentiation of these several parts depends of course upon the condition that no cause interferes with the changes which tend to that result. If a fungus disturb by its growth the formation of these parts, we are enabled, by observing the extent of the change, in the early stages, to calculate the depth to which the fungus has penetrated, and at a later date, how far the follicle is recovering itself—that is, where we can obtain any part of the follicular sheath. When the hairs are loose and come out easily, we rightly conclude that the fungus has penetrated deeply. Again, if the young hairs of a newly growing patch get loosened, and when pulled out have no follicular sheath, we should suspect that the fungus is relighting up into activity. It must be stated that it is the inner, or epidermic layer, that we have to deal with, the outer, or corium, cannot be obtained for clinical purposes. In a healthy state, this epidermic layer, containing the fenestrated membrane, comes out attached to the shaft and root of the hair; if the fungus in its progress of destruction reach half-way down the follicle, the root sheath, or epithelial layer, will be relatively imperfect; hence it appears as if the formation of cells proceeded from, and at the surface of, the basement membrane (through the outer vascular coat), in addition to the greater production at the more vascular papilla, this being a mere concentration, so to speak, of the dermic layer.

This view, which is by no means novel, that the formation of cells takes place over the general surface of the follicle at the basement membrane, is confirmed by the fact that where the follicle is damaged, or in part obliterated, nature will attempt to form a hair, but imperfectly, with a very short follicular part. The epidermic layer, in the course of its destruction, is replaced by a quantity of cells heaped *en masse*, of irregular outline, yellowish, dry, and more or less

infiltrated by fungus. In judging, however, of the extent of disease, we look to the state of the hairs; it is rather as a matter of prognosis that the condition of the follicular lining is important; hence it is only necessary to discuss its aspect in the stages of arrest and repair. When the young hairs are reforming, the only visible appearance of a sheath is a collection here and there of imperfectly formed scales attached to the hair when pulled out; by and bye, however, the cells themselves, and their order of arrangement, become more distinct.

The commencing formation of the fenestrated membrane is indicated by a layer of very pale cells, arranged in a peculiarly stratified manner, at the very lowest part of the follicle; and as growth advances, this becomes replaced higher up in the follicle at first by little bits of the true membrane. I have found, from very extensive examination of the young hairs in growing patches, that the presence or absence of this structure is a very valuable guide in the prognosis and treatment of the later stages of tinea. Directly its re-appearance takes place, we may be quite sure that no fungus is present in the follicle; of course the fungus may be re-implanted, but very very rarely, it appears, when the cure has advanced to that stage in which the follicle has so far recovered itself as, among other things, to reform the fenestrated membrane; hence its presence should be one reason for omitting the use of all parasiticides.

I know no case in which the structure of the fenestrated membrane can be more readily determined, than in connexion with the vigorous re-growth of the young hair after tinea. It is not always that the incipient root-sheath comes out nicely with the hairs, more particularly its lowest portion. The following appears to me to be the mode of formation of this peculiar structure:—At the lowest point around the knob of the hair, is found a layer of very fine oval, beautifully delicate cells, distinctly nucleated. This requires a good deal of care in its examination, for on superficial notice, the structure seems to be a homogeneous membrane, in which are imbedded free nuclei—the

truth being, that the cells do not dovetail, as it were, but leave little spaces filled with intercellular substance between them, which spaces give rise to the supposition of free nuclei; the membrane is made up at the early stage of cells. As this layer is traced upwards, the nuclei of the cells themselves disappear, and that very speedily, and the intercellular spaces (the periplast) elongate, get spindle-shaped, and more widely separated from each other, until at last a vestige only remains, and their place, and that of the cells, is supplied by fibres which interlace, and join in *an elongating direction.* These fibres are formed in the intercellular substance, and as they increase, they replace not only the cells, but lessen in extent and size the intercellular spaces of course, and come at last to form by their compactness the appearance of a membrane. Now, I am certain that the fibres are not formed from the cells, but by a fibrillation of the periplast or intercellular substance; and, as before said, the appearance of nuclei imbedded in a homogeneous membrane is a mistake. The so-called nuclei are least abundant where are the great number of fibres, and most abundant where the cells are most numerous, and are in reality intercellular spaces. In the perfectly formed part, the apertures in the membrane, inasmuch as the fibres occupy the whole of what may be called the site of the intercellular substance, must represent the position of the original cells which have disappeared.

Be these doubts as they may, I feel sure that at first there is a layer of cells with very little intercellular substance; that the latter increases, fibrillates, at the expense of the former, and comes by close arrangement to form a membrane in which spaces are left between the fibres, indicating the place probably of the original cells. It has always been taught by Dr. Sharpey that the structure of the fenestrated membrane is fibrous.

Glands.—The changes effected in the glands are very trifling, and comparatively of little moment. Some authorities still deny the existence of glands in the scalp, notwithstanding the observations of Bichat, Meckel, Simon, and

E. Weber. Grüby states that he has never detected the fungus in the glands; but in cases in which their sacs have come out attached to the hair-sheath, I have observed sporules attacking the epithelial cells of the sebaceous matter; whether this be of any frequency is difficult to say, as it is not an easy thing to obtain the gland sacs without cutting out a piece of skin. The glands often take on increased activity, and pour into the hair follicle much sebaceous material; they subsequently become damaged, it would seem, and the hairs become dry and harsh, on account of the loss of the usual secretion which keeps them glossy and pliant. In sycosis the glands play an important part; they are well developed, and their irritation modifies the aspect of the disease very materially.

CHAPTER VII.

Diagnosis.

Little difficulty can be experienced in regard to the more usual forms of tineæ. Confusion arises among those which partake of the scaly character of skin diseases, or in those forms of eruption which are generally regarded as non-parasitic, but may become complicated by the growth of fungi. Certain presumptive criteria have been alluded to in the early part of these remarks, but one feature has only been cursorily alluded to—viz., a peculiar state of the hair follicles, which seem to be the central points from which the eruption starts, or rather, on close attention, they are found to be peculiarly prominent, forming little points in the general area of the patch; and in all cases in which this is marked, especially if pruritus exists, the hairs and scales should be examined. Parasites may be present in almost all varieties of eruption, and may be secondary *quoad* the occurrence of the eruption, or primary and the real cause of the vesicles or pityriasis, &c., present. Artificial eruptions produced by the use of remedies can scarcely mislead; but those resulting from the presence and irritation of animal parasites may easily deceive; the avoidance of error, however, is a matter of care only. I have seen a condition of thigh, high up, close to the fork, produced by the pediculus pubis, at first sight resemble closely the furfuraceous variety of parasitic disease; there was intense itching, and a quasi-eczematous rash, which became branny, ill-developed, and in great part unsymmetrical, and evidently due to some local cause; no pediculi were visible in the pubic region, but at first only in the fork.

In the *erythematous* group, the diagnosis may be difficult. Erythema marginatum, E. circinatum, and the milder forms of tinea circinata, run together wonderfully in physical appearances; and I have seen tinea versicolor commence, and, in its early stage, present characters just like E. circinatum. In children, it is by no means unusual to meet with eruptions about the shoulders, neck, and chest, which are as much tinea circinata as erythema circinatum, and I have repeatedly detected and demonstrated the mycelial threads (and spores) of the trichophyton in these forms of rash, which are classed by many under the term "furfuraceous variety of herpes circinatus." I quite think they are the same in nature, and merely stages of one disease. Yet it is most important to remember that the state of the system at large appears to be peculiarly favourable to the spread of the eruption and parasitic growth. The children attacked are very often pale, pasty, and ill-conditioned (and it is remarkable how very luxuriant the mycelium is in some of these instances), so that general treatment is of first moment, and local treatment quite subsidiary, because the fungus has no very great hold upon the surface. Tinea versicolor may be ranked under the class of erythematous diseases, and is easily confounded, by those unacquainted with skin diseases, with several eruptive patches. Very many diseases end in furfuraceous desquamation, but are recognised at once by their histories. Chloasma differs from ordinary pityriasis in the existence of pruritus, the peculiarly circular or irregularly circular form; from ephelis (sun-burn) by its seat, viz., at those parts covered by dress, and its raised and furfuraceous surface; from lentigo (freckles), which is identical in nature with ephelis, by the same criteria. Very many authors use the terms lentigo and ephelis synonymously; it is better, however, to limit the use of the word lentigo to "the congenital form of pigmentary discoloration" seen especially in red-haired people, and the latter to the seasonal maculæ immediately dependent upon the action of the sun's rays. Maculæ syphiliticæ are isolated, circular, possessed of a dirty red colour,

exhibit no pruritus nor desquamation, and are accompanied by constitutional symptoms.

Papulous Eruptions.—Papulæ form a part of some of the minor parasitic diseases, which have already been considered. It is to be hoped that, in future, observers will be upon the look out for fungi in cases of prurigo, because of its peculiar localization. Mr. Hunt quotes a case (13) of prurigo pudendi, in which there were "two or three patches on the trunk of scurfy incrustration, which were probably papulous in origin;" a coincidence very suggestive of parasitic complication, though I know nothing of prurigo as produced by fungus growth, I confess. Another form of papulous eruption may really be of parasitic nature, viz., Lichen pilaris. In the case of chronic eczema of the thighs before noticed, the parasite had found its way to the hairs, and had produced thereby a dotting of the general surface of the eczema (chronic), giving rise to the appearance (in places), figured by Mr. Wilson in his work as Lichen pilaris, which is, by the bye, a very obstinate form of disease. The diagnosis of the simple and parasitic variety would be determined by microscopic examination of the hairs and scales around the hairs. That no misunderstanding may arise, it is worth repeating, that though a fungus be found, it is not necessarily (usually it is not), the cause of the eruption, but simply an additional irritation. The epithelial disease is in the preponderance as compared with that of the hairs.

Vesicular Diseases.—If the vesicles are well marked, no error can arise, as in the phlyctenoid variety of herpes and the acuter forms of eczema. Tinea (or herpes) circinata is always parasitic, and its relation to erythema circinatum has been alluded to. Herpes iris is a very rare affection. The only marked example which I have met with was at University College Hospital, a few years ago. The patch was situated on the back of the right hand, over the metacarpal bone of the index finger. I examined the hairs and scales microscopically, and detected a parasite. My impression at the time was that the disease differed from herpes circinatus in the fact of its occurring in a syphilitic subject; it

was unsymmetrical. The sulphurous acid applied a few times met with entire success.

Eczema of the scalp sometimes assumes the aspect of tinea. Alibert described two stages, under the significant terms teigne furfuracée and teigne amiantacée; and it was long classed under the head of porrigo, and the like with true ringworm. Now that the true pathology of these diseases is understood, the microscope at once completely distinguishes them. In eczema the hair gets thinned, and its growth is not vigorous; but the bulbs of the hair are not affected, or only temporarily, to an inappreciable degree, in consequence of the dermic inflammation when this is excessive. In cases of chronic eczema complicated by parasites, the hair follicles will be prominent, and, as it were, dot over the general surface; but microscopic examination alone can decide as to diagnosis in ordinary cases. The condition of any patch is tolerably uniform; pruritus would appear to be suspicious.

Pustular Diseases.—In impetigo, when the crops of pustules are few, and dry up, matting the hair together, it is not very dissimilar to favus of old standing; and this is confirmed by reference to the various appellations which have been given to it at different times. When the pustules are sparse and "desiccate," it has been called teigne granulée by Alibert. The cups and the microscopic character of the favi suffice to settle any dispute. It is when the favi get dry and split up that the aspect of impetigo granulata is assumed; but the loss of hair is absent, and there is plenty of moist discharge in the latter.

Impetigo may resemble tinea sycosis, but wants the indurated base, and its pustules are not seated at the hair follicles exclusively, nor are they acuminated, but grouped or clustered. Moreover, the crusts are large, and there is much discharge, which "concretes" into crusts.

Syphilitic pustules differ from those of sycosis in being "flat, broad, and glossy," of a copper colour, in not being localized to those parts attacked by tinea sycosis, for they are seen alike on the forehead and side of the nose. They

are accompanied by very little pain, or feeling of tension, and leave behind more or less ulceration. It is rather in the indurations that are left behind in either disease, after the more acute stage is passed, that the similitude is likely to be deceptive, and, under these circumstances, the non-localization of the tubercles and the presence of secondary symptoms elsewhere will help to point out the syphilitic nature in the one case. A little attention will distinguish acne from sycosis—in acne the sebaceous follicles generally are affected, and the hairs are healthy. Leuckart has found a parasite in it, resembling the puccinia however.

Lepra vulgaris, in the progress of cure may, as suggested by the name given to it by Alibert of herpes furfuraceus circinatus, approach in its aspect that of tinea circinata, or indeed, tinea tonsurans, but could hardly be confounded. It has been expected, perhaps, that more would have been said in reference to the physical characters of various eruptions, in so far as they indicate the differential diagnosis of parasitic and those non-parasitic diseases which put on similar appearances; but it appears to me that these characters are of secondary importance, and of little value as decisive tests. Any of the ordinary forms of eruption may become the seat of the growth of fungi, and in such instances the criteria derived from external differences must be almost valueless, inasmuch as the parasitic and non-parasitic phases differ but very slightly from each other in outward aspect. At the outset a summary was given of those appearances and phenomena which, taken together, are presumptive that a disease (more especially such as may be classed under the head of chronic skin diseases) is produced by the presence of a parasite. Again, the vesicles of herpes, the pustules of impetigo, and the scales of pityriasis may be the result of fungus growth, and yet the outward appearances offer no positive proof of the existence of the latter. Of course, in such as favus, tinea tonsurans, and the like, the diagnosis can be made at once and most unhesitatingly by the naked eye appearances alone, but not so is it with all cases. One mark of parasitic complication is certain in its teaching;

in those instances in which fungi are absent, the hairs of the part come out in a straight manner; they are not twisted, bent, dry, shrivelled, and so on; and where the fungus is present, there will always be found disease of the hairs and epithelium. No diagnosis should be considered complete in any cases in which we suspect parasitic complication that has not been well tested by microscopic examination. The pathognomonic lesion of tinea is not eruption, but, as has been argued at the commencement, the alteration of the hairs and epithelium. I wish to indicate by these remarks the necessity of distinguishing skin diseases which run a chronic course and bear a "scaly" aspect, into parasitic and non-parasitic groups, a division which has an important bearing in a therapeutical point of view, inasmuch as it recognises a special source of irritation and prolongation of the disease. The recognition and appreciation of this important distinction in no wise complicates existing opinions. In any case in which the presence of a fungus is suspected, pull out some of the fine downy hairs, let them soak in ether, wash them, and then add liq. potassæ; now examine, and if any highly refracting bodies remain, they are fungus elements, or the mycelial threads may be detected. The practical point in a diagnostic point of view is not that there can be any doubt in a well marked example in regard to microscopic characters, but in an early stage to be able to say this *is* and this *is not* complicated by parasitic vegetation. Now the hairs may be examined and found to be tolerably well formed, but the distinction into cortical and central part is nil. Little masses of epithelial cells stick to the shaft in an unequal manner, which exhibits throughout or only here and there a diffused granular appearance, bulged now and again, the enlargements being chiefly the seat of the granular infiltration. In such a case it may safely be concluded that a fungus has been at work, though satisfactory evidence of it must be sought for. The root of the hair, too, looks short, small, and perhaps breaks across at the widest part, where is the same granular appearance. Not unfrequently after the hair has soaked some time, a few spores can be seen in the

epithelium adherent to just above the root of the hair, and if a high power be used, the granular collections are seen to be made up of very minute cellules. The fungus, however, is best exhibited in the little stubs which are to be found almost in every parasitic patch. I have repeatedly seen the granular stroma develop into true sporules. In the earliest stage of favus, there is said to be an hypersecretion of epithelial cells, accompanied, not by the spores of the achorion, but by "molecular matter;" but this molecular or granular matter is really the early stage (the nuclear condition) of the more fully developed fungus. The presence of hairs with ill formed roots, adherent epithelial cells in little mass here and there just above the root, and local bulgings which are the seat of granular infiltration, is, according to my own observation, sufficient evidence of the existence of a parasite, or at all events sufficient to call for some local parasiticide, such as tincture of iodine. The granular stroma may produce splitting up of the fibres of the hairs. The fungus may of course be also detected in the epithelial scales of the diseased patch. The diagnosis must be based upon the proposition, that nothing but a fungus can produce distinct damage of the hairs and epithelium.

CHAPTER VIII.

Prognosis.

Every one must learn for himself by careful observation the various minutiæ which determine any prognostic opinion. in this place a few of the leading indications which serve as guides will be noticed. A spontaneous cure is rare, and *no case is so bad as to be utterly incurable.* Due regard must be paid to every ordinary peculiarity of temperament, as well as to the aspect of the local lesions. Whenever the scrofulous diathesis is marked, either in the family history, the physical conformation of the patient, or both conjoined, the cure will mostly be tedious. Favus, according to Mr. Hutchinson, has an average duration, so far as the details of recorded cases show, of seven years, and many instances have been known to last for twenty or thirty years. Modern practice, however, has made very great progress in the cure of this disease, and the occurrence of a favourable issue may be looked for at the expiration of from five or six to twenty weeks, according to the severity of the particular case. Tinea tonsurans occurs more especially in the subjects of the tuberculous crasis, and offers much less opposition to the good effect of treatment. The average duration of *severe* cases of tinea tonsurans, I take it, ought certainly not to exceed three or four months. As regards sycosis, a good deal of caution is requisite; if the patient be temperate, non-syphilitic, and non-tubercular, a favourable prognosis may be given, that is to say, if not contraindicated by any *local* state. One of the most obstinate cases of sycosis I ever saw occurred in the person of a medical man who was mark-

edly tubercular; and I have found patients affected with sycosis peculiarly indisposed to carry out steadily any definite plan of treatment. It appears to have been my lot to witness the disease in free drinkers, who have looked forward to "change of season" for an abatement of the symptoms, and whose irritable condition of temper has declined the efficacy of the heroic treatment by epilation or the continued exhibition of arsenic. In the minor forms of disease, *ex.* tinea circinata, chloasma, and indeed, tinea decalvans, the prognosis is wholly decided by the local features of each variety; and in any chronic scaly skin eruption complicated by parasitic growth, as the fungus is most readily destroyed, the prognosis is that of the eruptive disease itself, the detail of which is not demanded here. Many children present themselves with an anæmiated aspect, being otherwise tolerably healthy; and in such cases general treatment is of most decided benefit, and the best prognosis may be given. Generally speaking, unsymmetrical eruptions are not obstinate in character.

Local guides to prognosis.—The most important point to ascertain, when the disease first comes under observation, is the length of time it has already existed. The age and extent of the malady must be accurately distinguished. If the disease be recent, no matter how extensive, the prognosis is infinitely more favourable than in old-standing though limited tinea; the fungus takes some time to travel to the bottom of the follicle, and it can be reached and easily destroyed in an early stage of disease. Tinea of old standing will assuredly get well, provided the patient follow out implicitly the directions of the medical man, and the latter pursue a regular, careful and decided course of therapeutics; in such instances, the fungus must be destroyed, the soil altered, and the lesions remedied, all which require time. The character of co-incident (be they antecedent or consecutive) eruptions must be considered. A solitary, unsymmetrical patch is rarely tedious in its cure; if symmetrical and multiple, the disease is prolonged usually by some peculiar constitutional diathesis; but as this is mostly seen in the scaly skin diseases, the parasite has little hold upon

the surface, inasmuch as the hairs are few and the follicles not very deep; hence the prognosis of the parasitic complication is entirely favourable, and quite secondary to that of the eruption itself. If a pustular condition is present, and not due to the application of parasiticides, the case will be very obstinate, and in a less degree so where an eczematous type of eruption is co-incident.

State of the Scalp.—A puffy and œdematous condition, if not the effect of remedies, indicates that the tissues are irritable, and that the structures, especially the hair follicles, are likely to be considerably damaged, and alopecia the more severe; it occurs in delicate and cachectic subjects most markedly. In chronic cases, insensibility of the scalp to remedies, such as blistering, shows that the circulation is considerably lessened through the induration, sometimes atrophy, the consequence of prior inflammation; and here there is great fear that the formative apparatus of the hair may be extensively disorganised.

The appearances presented by the hairs, as to extent of damage, the ease with which they come out, and the condition of their sheath.—Little black stubs accompany a very thorough invasion of the fungus, and are crammed full of spores; if the hairs are much split up, the fungus exerts considerable force, or, in other words, is actively growing; infiltration by the sporular or nuclear form, indicates free reproduction of the parasite; the hairs are frequently bent at a varying angle, just beyond the follicular orifice, and here the shaft is infiltrated by fungus elements. If the root is tolerably well formed, and there is only a small quantity of epithelial matter adherent to the follicular shaft, and spores are sparse, nature is probably *attempting* a spontaneous recovery; the worst cases are those in which the hairs are filled with spores, which give it a dark, dull aspect, and split it up into a fibrous mass, which snaps off when an attempt is made to extract it from the follicle; imbrication of the shaft by epithelial scales, and a certain amount of pigment, are good signs; the more the roots are atrophied the greater is the damage to the papilla.

A firm attachment to the follicle is favourable. If the hairs come out easily during treatment, with little curled blackened roots, there is probably a fungus deep in the follicle, and left behind after epilation to attack the succeeding newly formed hair.

The inferences to be drawn from the state of the lining membrane of the follicle has been fully alluded to already.

The amount and development of the fungus must be taken into account. If the tubular condition be present in a well marked form (beaded), and the spores abundant also, no doubt the parasite has found a very fitting nidus for growth.

In the stage of arrest, it becomes at times, a difficult matter to say in which direction the ebb is taking place; wherever in any patch which presents an apparently healthy scalp, here and there little yellowish scurfy incrustations make their appearance, and the hairs seem to be dry, to come out easily, and fail to stand up as it were to the same level as those of the surrounding part, the disease is recommencing. Very often little erythematous spots precede these changes. If, again, on the other hand, the hairs are gaining bulbs, and on extraction their epithelial sheath comes out attached to them, the case is progressing favourably.

I think it, perhaps, better not to enter into the full detail of each variety of tinea. There is one instance, however, that is worthy of special notice, and it is sycosis; though this is not the severest form of disease, the prognosis should be more cautiously given than in any other, on account of the difficulty of applying appropriate treatment for its annihilation. Patients will not submit to epilation, and the like. In making any prognosis, the *general* and *local* conditions must be conjointly taken into account.

PART II.

CHAPTER IX.

General Remarks on the Relationship of Fungi.

I come now to the consideration of the Second Division of my subject, viz., the *relations* of the parasitic fungi. Professorial chairs in England teach that the parasites found in the several varieties of tinea are separate and distinct in nature. On the other hand, continental authorities have of late lessened the number of epiphytes. Bazin, for instance, recognises three only, that of tinea favosa, that of t. tonsurans, and that of teigne pelade (decalvans); and he believes the mentagrophyte of Grüby is identical with trichophyton, admitting, moreover, the difficulty of distinguishing the worst forms of tinea tonsurans, and the form of favus styled scutulata.

Hebra holds the identity of tinea favosa and tinea tonsurans as established, and the probability of a similar relationship between all the human parasites. We have the authority of Müller, Retzius, Lebert, and Remak, for classing the achorion and oïdium together; indeed, Robin places the former, in his work, as a separate genus under the head of oïdiés. Berg, again, after careful inquiry, concluded that Leptomitus Hannoveri and Bennett's fungus are oïdium. The nail fungus is looked upon by Virchow as an aspergillus, and Küchenmeister is inclined to assent to this view, though he has much reason to think that it resembles an oïdium. the fungus found in the ear is, according to Robin, an aspergillus, whilst Sluyter makes it a mucor. These examples, a few among many, suggest an absence of criteria sufficiently important in themselves to differentiate species,

and the probability, to say the least, that some of these fungi, usually regarded as distinct, are in reality identical in nature; still, however, the greatest reluctance is felt in discussing this view of the case, due no doubt in part to the difficult nature of the inquiry, and in part also to the circumstance that the investigation of the subject seeks at the hands of observers more time and patience than the great majority can afford. Of late, Dr. J. Lowe has led the way towards the solution of the various points at issue in his pamphlet "On the Identity of Achorion Schonleinii with Aspergillus Glaucus and other Parasites;" and would appear to have established as actual fact the production of the latter from the former. It is unquestionably due to Dr. Lowe to state that he was the first to show by experiment this identity (*Edin. Bot. Soc. Trans.*, vol. v. 1857). Mr. Hogg subsequently, in 1859, confirmed Dr. Lowe's observations, and in the same year I recorded in the *Lancet* certain arguments which led me to believe that all parasites found on man possess a common origin.

It is generally held that the spores of fungi are perfectly disseminated through the air, and that each particular epiphyte becomes developed in turn according as it meets with its suitable nidus. No doubt this is true as a rule, but it is equally indisputable that the same fungus assumes varied forms under the influence of different agencies. The following are very familiar instances. Professor Henslow proved that uredo rubigo (of corn), and puccinia graminis (mildew), are the same, the former being the early stage of the latter (*Ann. Nat. Hist.*, vol. vi. p. 379). Again, Dutrochet took a solution of albumen and examined it from time to time. At the expiration of a year nothing had occurred; he added some acid, and monilia was produced; conversely he added an alkali, and botrytis resulted. Thinking that the agency of the reagent might have had some special influence, instead of albumen he used fibrin, and, curiously enough, he obtained just the very opposite result. Fibrin and alkali grew monilia, and fibrin and acid botrytis. There is a well-grounded conviction in the minds

of many intelligent farmers, and indeed botanists, that diseased Barberry bushes give rise oftentimes to the blight of wheat, and from time to time numerous well-authenticated examples have been recorded. Some have looked upon the evidence as implying merely a coincidence, and Professor Henslow, in the *Journal of the Royal Society of Agriculture*, Part I., in a paper on the Diseases of Wheat, expressed a doubt whether there be any real relation as cause and effect between the two things; but recent observation would seem to establish satisfactorily the occurrence of blight by the transplantation of the fungus (Æcidium Berberedis) of the diseased Barberry. The distinctive characters of the rust fungus and the æcidium are very unlike, but this is no reason why the two may not be different forms of one and the same fungus. Botanists acknowledge the principle *of diversity of form produced by varied conditions of soil and other influences* readily enough in the case of the higher kinds of plants, *ex.*, wheat, &c., but, unconsciously as it were, contradict themselves by repudiating it in the lower orders of vegetation, which of all others are most especially liable to suffer change under the action of the same external influences, and exhibit the very best examples of the principle in question.

The history of parasitic animals is only another illustration taken from the other great division of living things, of the same law. It is now well established that the cysticerci cellulosæ (measly pork) become in man tæniæ (Küchenmeister, *Wien. Med. Wochenschrift*, No. 1, 1855); and cænures (staggers), cysticerci, and tæniæ are interchangeable (Küchenmeister, *Comp. Rendus des Séances de l'Acad. des Sciences*, 17 Avril, 1854). Cystoid, and cestoid, and nematoid (?) worms are modifications the one of the other, according to Küchenmeister, Leuckart, and Von Siebold. Recent observation has illustrated this difference of conformation dependent upon difference of nidus, &c. in the case of the bothriocephalus. The occurrence of this entozoon has some connexion with "ichthyophagic habits;" and probably some fresh-water creature forms the nidus for the development of that phase which, introduced into man, becomes

the perfect worm. In a recent work by Dr. Knock on the "Helminthologia of Russia," appears the following:—"We ourselves, during a residence at St. Petersburg, had the desired opportunity of observing the development of this entozoon, and the metamorphosis of its ciliated embryo in water, as also of its ultimate transference to the mammalia, through the medium of river-water as drink." "The embryos of the bothriocephalus latus develope their ova only after remaining months in fresh-water, as infusorial ciliated organisms, moving actively about for several days, and finally becoming transferred to the human system." (*Petersburg. Medicin. Zeitschrift*, 1 Jahr, 1861). These, among other facts, have led most to believe that the kind of animal parasite present depends upon the special soil which they inhabit, and that very many, apparently different, are mere variations of a common origin.

In determining species, we should take care to be guided by the "*assemblage of characters furnished by the entire organization.*" The past history, not only of many of the lower animals, but also a large number of the members of the vegetable kingdom, exemplifies the necessity for this caution markedly, and illustrates as well the proposition of Milne-Edwards (*Ann. des Sciences Nat. N. S. Zool.*, tom. i. p. 65), anticipated to some extent by Dr. Barry (*Ed. Med. Phil. Journ.*, Jan. and April, 1837), that "by the study of development we are enabled most certainly to distinguish between those *essential* characters on which affinity depends and those *accessory* characters which are engrafted upon the original type for some special purpose." The upshot of the matter, as bearing upon the subject under discussion, is just this, that the same species may exhibit a variety of forms at different stages of development and under different influences. "The element of mutability pervades the whole vegetable kingdom" (Hooker). Species vary most (relatively speaking) as we descend from complex to simple structured forms; in the former there is less departure from the *type*. The mode of propagation, too, has great influence upon the determination of species, and the appearance of "stability"

is given to many variations by *budding*, which propagates the individual, not the race—for example, fissiparous division, which is a form of budding, would reproduce any existing peculiarity, whereas, if the conjugation of different parents takes places, the original or some modified phase might result. "Neither size nor outline affords any basis for distinction into species, until it has been ascertained from extensive comparison of forms brought from different localities in the widest area over which the species can be traced, what are the average characters of the type, and what is their range of variation" (Bentham). The tendency of the present is to lessen the number of existing species—not, however, to the extent that some modern hypotheses would compel us to go. For example, with regard to epiphytes further observation will, in all probability, completely establish their identity in nature with the ordinary forms of mould, but never with all fungi—such, for instance, as the agaric group, and it behoves us to be doubly cautious in accepting anything as fact, inasmuch as the scientific man is apt to be influenced by the strongly expressed opinion of very high authority.

In reference to human parasites, the medical man has little time (and opportunity) to study them in a *botanical* sense, and regards them with little concern compared with what he considers the more important, viz., the diseases in which they occur; in other words, *as accidental products.* The botanist rarely meets with these fungi, and then loses in his research the help derived from their consideration in conjunction with the medical aspect of the cases in which they occur; and, as might have been expected, they have never been studied in an enlarged sense. Observers have never considered how far the several modifications of form are produced by varying concomitants, such as different soils, different external agencies, and different stages of development.

It would be an omission of some gravity if reference were not made to the subject of spontaneous generation. This has been put so clearly and forcibly by Dr. Budd, in the

British Medical Journal for December 7, 1861, that I am content to quote his words, only premising, as Dr. Watson has it, that "this doctrine of equivocal generation shocks my mind and offends my reason." "It is open," says Dr. Budd, "to the partisan of spontaneous generation to argue, if he will, that the mildew and the tapeworm may, for aught we know, and in spite of all evidence to the contrary, still spring up anew. But the naturalist having discovered in both these types a mode of reproduction containing ample provision for the maintenance of the species in the very way in which it is observed, and having further found that the hypothesis of spontaneous generation breaks down when brought to the test of experiment in any given case, has rightly declined, in the absence of all proof, even to entertain such a proposition." "Spontaneous generation is in fact not only a pure hypothesis, but of all hypotheses the most gratuitous." The evidence in its favour "is negative only, and consists solely in our inability to trace with the eye the continuous chain whose connecting links are known to be invisible." "It will be seen that I have not thought it needful to refer to M. Pouchet's recent attempt to re-open the question of spontaneous generation before the French Academy of Sciences, in a series of experiments which, according to his own view of them, answer that question in the affirmative. I quite agree with M. Quatrefages in thinking it only remarkable that the experiments should have imposed for a moment on men of eminence. All M. Pouchet's results have been upset by those since obtained by M. Pasteur," who confirms Schwann and Henle's experiments, that "if the air admitted to organic infusions be first subjected to a high temperature or the action of strong mineral acids, no living being ever appeared in them;" and has further shown "that the same result may be obtained by merely giving a form to the apparatus which mechanically prevents access of organic germs to the liquid. Moreover, that if the infusion supplied with air thus acted upon be artificially sown with organic germs, it soon swarms with the most flourishing organisms." There are indeed situations

in which fungi are found which offer very considerable difficulty to the opponent of spontaneous generation, as, for instance, the interior of the egg, the pelvis of the kidney, or the fluid in the ventricles of the brain. It is supposed that the germs of the fungus find an entrance to the interior of the egg within the body of the bird before the formation of the shell, and, through the agency of the circulation, to the interior of the kidney. We may be pretty well sure that the germs are derived, at some period, *ab externo*, and that the difficulty is rather occasioned by the unwillingness of the observer to be guided by general laws, and the self-satisfied value of his own limited observation.

The existence of fungi is pretty general, it would appear, not only upon the exterior of man, but also the analogous parts of the lower animals. In the *Proceedings of the Royal Society*, June 9th, 1859, is a paper entitled "The Frequent Occurrence of Vegetable Parasites in the Hard Structures of Animals," contributed by Prof. Kölliker. These fungi are all of them unicellular. Kölliker has found them in Sponges, Foraminifera, Corals, Bivalves, Brachiopods, Gasteropods, Annelids, Cirrhipeds, and Fish (scales of Beryx ornatus), and thinks that they dissolve the carbonate of lime of the structures into which they penetrate by the exudation of carbonic acid, which is given off from the growing ends of the fungial tubes, and in some cases they make head by mechanical (? vital) force. It appears that Wedl anticipated Kölliker in a communication made to the Vienna Academy, Oct. 14, 1858, of which Kölliker was unaware at the time he made known his own researches. Quekett, in the case of corals, *Lectures on Histology*, vol. ix., pp. 153 and 276; Rose, *Trans. Microscop. Soc.*, vol. x. p. 7, 1855, in fossil fish; and E. Clarapéde, Müller, *Archiv*, 1857, p. 119, in the test of Neritina fluviatilis, noticed the same appearances, though they did not prove the vegetable nature of the foreign elements. The drawings of Kölliker certainly exhibit fungi the exact counterpart of those growing on man. The shells in the cabinet of the naturalist are often found to become quasi-pulverulent and friable, especially if

in contact with the damp. A microscopic examination will frequently detect a fungus, whose growth most likely, on account of the extrication of carbonic acid gas, causes the disintegration of the shell; an account of this change may be found in vol. vii. of the *Microscopical Transactions*, by the Rev. H. H. Higgins. The fungus is a *mucor*, with a globose sporangium.

In harmony with the foregoing remarks we may conclude,

1. That all germs of fungi are derived originally *ab externo*, and do not arise by spontaneous generation.

2. That the same fungus may present different aspects under different conditions.

3. That the existence of parasites in the exterior of animals and man is pretty general.

With these preliminary observations, which indicate the direction in which the present teaching of science points, I pass to the consideration of the relation which the several varieties of tinea bear to one another.

CHAPTER X.

Insufficiency of the Differential Criteria of the Tineæ.

My first endeavour will be to criticise and explain away as useless the criteria which are generally considered sufficient to mark the tineæ into distinct varieties; they are to be found in fluctuations of the following:

1. Secretion (including eruption).
2. Amount of disease (*i. e.*, degree of luxuriance).
3. Rapidity of growth.
4. Seat; (A) general, (B) local.
5. Microscopic characters of the fungi themselves; their differences.

Fluctuations in the above would appear to be wholly explicable upon the supposition of the identity of parasitic fungi. If we view the tineæ as a whole, strong evidence is forthcoming, and indicates that they form a perfect gradating series, as regards amount, kind, and degree of development in its various aspects, from the minor cases of tinea decalvans to the severest forms of favus, which may not inaptly be expressed as follows:

1. The plant just able to live and do damage, with but little activity, frequently after awhile dying off; this is tinea decalvans, idiopathic, non-eruptive, and comparatively rare. Under the same head may be classed those cases of "falling out of the hair," without any other appreciable changes, from a localized spot, which, however, are not circular, though they gradually assume the character of tinea decalvans.

2. The fungus on a more favourable soil producing irritation (erythema at the outset), and it may be (consecutive) eruption; at any rate increased secretion of epithelium. Under this head the mildest forms of tinea tonsurans, chloasma, and "herpes circinatus" place themselves.

3. The epiphyte upon a still more fitting soil, with the presence of eruption to a marked extent, but *still consecutive;* the fungus itself in a higher degree of development, spores getting oval, joined, the mycelium straight, broad, branched. Examples: Tinea tonsurans, plica polonica, &c.; sycosis, favus in its mildest forms, and some chronic skin diseases complicated by parasitic growth.

4. Secretion exists (antecedent), an index of the best possible soil; the fungus finds its way thereto, and flourishes most luxuriously. This is favus.

Now cases are not of very unfrequent occurrence which cannot be assigned with satisfaction to any particular variety of tinea; they are as much tinea favosa in a mild form as tinea tonsurans, or as much tinea tonsurans as tinea circinata, and where the microscopic characters afford no help, the inability to distinguish, at times, thoroughly between the instances given, readily explains the confusion in the use of the term porrigo scutulata. Some authorities have limited it to tinea tonsurans, and others to a variety of favus. I know the opinion here stated is contrary to the experience of good authority, but the difficulty has occurred to me in many instances of defining clearly the location of the particular instance under examination. I have seen in the same subject the physical appearance of two so-called different tineæ as separate stages of one disease. This is in unison with the like statement made by Hebra with regard to favus and tinea tonsurans, and Bazin concerning the latter, tinea circinata, and tinea sycosis. Reference will be made to this presently.

1. The first mark of distinction to be discussed is Secretion, its degree and kind. The naked eye characters of any variety of tinea are of course materially influenced by this condition, existing now to a slight extent, now in a marked

amount. If irritants be applied in varying proportions to the same skin, or to that of different subjects in equal extent, the result is not the occurrence of the same, but of multiform eruptions, according as the cause is more or less active—or, what is more certain, the blood state more or less that of the eruptive habit. Hebra, indeed, has by this method established an artificial division of eczematous diseases into the five varieties—Pityriasis rubra, E. papulatum, E. vesiculosa, E. rubra, and E. impetiginosum. So with fungus disease: the degree and kind of eruption surely in some measure depends upon the kind of soil present. The parasite will give rise in one instance to no eruption (as in tinea decalvans), in another to erythematous (chloasma), in another to vesicular (tinea tonsurans and tinea circinata), and rarely to pustular inflammation (sycosis and favus). The concomitants witness to the truth of this assertion—where most secretion is, there also will the parasite be most flourishing, most abundant, and most developed; the spores large, oval; the disease the deepest, most acute, and the most obstinate, and fructification most likely to occur under these conditions. The worst cases are they which become engrafted upon pre-existing eruptions. It is true also that the more you remove this naked eye difference (secretion) from the one, the more you approximate some other variety to a certain degree. In tinea tonsurans, by keeping up an amount of irritation less than sufficient to kill the parasite, and yet enough for the production of pustular or eczematous fluid, in which the fungus will vegetate if left undisturbed, I have produced on a minor scale a crust depressed in the centre, and pierced by hairs in various stages of disease, the crust being made up of epithelium, effused fluid, and numerous spores and mycelial tubes, having the characters of the achorion. This, however, could only take place in the very worst forms of disease. I remember, some time ago, two very bad cases of tinea tonsurans came under notice in two boys (brothers,) which were evidently making very rapid increase; and after carefully examining the scalp and the hairs microscopically, the remark was made that the

cases were very like the early stage of favus; but very prompt treatment was adopted, and the further progress of the growth checked.

I mention this fact to show that I am not riding any hobby, nor straining the point too far, in stating that the external characters of the two instances approach each other at times in similarity, and am only confirming the opinion of such dermatologists as Hebra and Bazin. Very recently I treated a case of favus which presented in some spots an appearance very similar to that of sycosis, and might very well have received the old name of Sycosis capillitii, only it was simply a portion of the general disease. The front part of the scalp, on account of long-continued irritation, was generally swollen and reddened; the follicles were thickened and stood out from the surface in some considerable degree of prominence; around each follicular orifice in some parts there existed a yellow circle, which, on examination, was found to be composed of puriform fluid, fungus, fat, and epithelial scales. The continued application of strong parasiticides for a long time having materially checked the growth and activity of the favus. Other portions of the scalp were covered by a thin layer of secretion, and the hairs bent, dry, and dull, easily breaking off a little way from the follicle when the attempt to pull them out was made. Now, it was the absence of secretion here and its presence there, that in some degree modified the character of the favus, and rendered it no difficult matter to recognise some relationship between it and the other tineæ. It is most especially, however, in the case of sycosis that we appreciate the influence of secretion in modifying the aspect of tinea.

In the report in the journals for February 16, 1856, of the meeting at the Pathological Society, Mr. Hutchinson is stated to have shown cases of ringworm exhibiting appearances as follows: The "patches looked more like a thickly-scaled psoriasis than ringworm (tinea tondens). The hairs of many of them passed through the crusts whole and unbroken, and grew to some length. Under the microscope many hairs were seen to be surrounded on all sides by

epithelial scales and sporules of the fungus, but themselves not invaded by the latter; the majority were, however, eaten into in the usual manner, and broken off at the end. "The sporules were much larger than those ordinarily found." Mr. Henry Thompson asked "whether the peculiarities alluded to might be explained by supposing that in this case favus and ringworm existed conjointly?" to which Mr. Hutchinson gave a negative. This detail has little significance taken alone, but carries weight when added to the general mass of facts. I take it that the unusual aspect of the case, having into consideration the character of the spore (unusually large) did approach somewhat towards favus. In some cases of tinea circinata, distinct vesicles are present in abundance; in others, in reality there is only furfuraceous desquamation or papules, when the disease may with perfect correctness be named erythema circinatum.

2. *Amount of Parasite, i.e., its degree of development.*— It is the full development of the fungus which gives favus its peculiar aspect; if the favi be removed, the more the aspect of the other tineæ is approximated; the similarity is again portrayed in the decline of favus. Dr. John Lowe, in some criticisms of a former paper of mine, bears me out in this statement. The contrast, nevertheless, exhibited by such a disease as tinea decalvans is regarded by most as quite sufficient to mark a distinct affection. The external characters are apparently diagnostic, and the minute one may be peculiar to some extent, the spores being small, the mycelium ill-developed and wavy; but from these alone no sure diagnosis could invariably be made.

The fringing in tinea tonsurans around the orifice of the follicle, depends upon the presence of a considerable amount of fungus; and it needs but the rapid development of the latter to produce a cupped condition, like favus, and no doubt this would take place if the soil were suitable.

The way in which the amount of parasite may modify the aspect of tinea is (rarely) seen in those instances in which short stubby hairs are retained in the follicle. The parasite continues to grow, the follicle thickens and becomes

more prominent, the hair occupies the centre of a little circular patch depressed in the middle (where the shaft of the hair makes exit), and made up of epithelium, effused fluid, and fungus elements. I have seen such a condition as this once in tinea circinata of the general surface. Of course there is no favus cup here, because the component elements are so different, but a very great similarity would be produced if their relative proportions were altered.

3. *Rapidity of growth.*—Favus has by far the most rapid power of growth, but all varieties of tinea arrange themselves, in regard to this feature, in an order not opposed to but confirmatory of the theory of their close relationship, with one apparent exception in the case of tinea decalvans. It has been before stated that in all probability observers have been mistaken as regards this variety, which is perhaps the least acute of any; alopecia is the *finale* of disease which has been in existence for a considerable time. It will sometimes happen that a patient will present himself with a patch of tinea decalvans, which is speedily rectified; but after some weeks, it may be two or three months, he returns with another spot somewhere in the neighbourhood of, perhaps at the part of the scalp immediately adjoining, the old patch. Now, the second attack may be looked upon as perfectly recent, or, on the other hand, as a remnant of the pre-existing disease; the latter is true, I am quite sure, in some cases, and at the time the original patch was under treatment and cure, a fresh implantation had taken place, and of this *no manifestation* occurs until some time afterwards (the date of the second occurrence of alopecia). This view seems to be confirmed by the fact of finding at different times, during the progress of the case, the hairs of the adjoining part coming out easily, with more or less disease of their roots, and that the application of remedial measures, not only to the bald patch, but also the adjoining circle of scalp, is most beneficial in preventing recurrence or extension after apparent cures. Further observation will, I believe, show that tinea decalvans is not of "rapid growth," but possesses a stage of considerable duration prior to the occurrence of alopecia, which is,

however, unappreciable by external characters, such as eruptive manifestations and the like. It is necessary to call attention to this point, for some assert that tinea decalvans is a separate disease, *because, among other things,* it differs in the rapidity of its evolution, the co-existent circumstances being contrariwise less in degree, compared with the other varieties of tinea. And this is the only practical matter which calls for notice under this head.

4. *Differences in the Seat of the Disease.*—This has reference to the general and also to the microscopic seats, the former of which has been alluded to. The latter exhibits variations of degree, not of kind, affording no ground for believing in the existence of distinct species of tinea.

All tineæ have one common starting-point for the fungus growth—viz., just within the follicular orifice, and from whence the fungus extends in varying extent, but very little way in tinea versicolor, still further in chronic skin diseases and sycosis, and down to the bottom of the follicle in tinea tonsurans and favus; thence it gets into the interior of the hair. Relatively speaking, these statements are true in the majority of cases. In tinea decalvans and some of the minor instances of parasitic diseases, the fungus after awhile dies out, or the follicle recovers itself, and the fungus which has done the mischief present is carried up, on or in the growing hair. The influence of moisture comes into play very perceptibly, for fungi do best when this exists, provided other circumstances are favourable. In tinea tonsurans there is less moisture than in favus, as a rule; hence the better development of the fungus of the latter is partly accounted for by this fact. The sebaceous matter poured into the follicle in sycosis affords a peculiarly fit nidus for the spores to develope, and this may possibly account for the appearance of the sheath formed by the mentagrophyte around the hair, supposed to be characteristic of sycosis.

In chloasma the influence of perspiration may determine the preponderance of fungus to the superficial structures. It is said that the peculiar seat of the trichophyton is the interior of the roots of the hairs; that of the microsporon

mentagrophytes (sycosis) around the shaft of the hair; that of microsporon audouini on the hair, a little way from the follicle; that of microsporon furfur the under surface of the epithelium. No doubt the *predilection* is as implied above, but by no means is there any constancy in, or limit to, the seat of any of the fungi. I have just indicated, in the case of chloasma and sycosis, the probable reasons why the fungus is seated in the one case in the superficial structures, and in the other around the hair in the follicle. With regard to tinea tonsurans, for my own part, I have never seen any evidence to justify the assertion that the seat of its fungus is limited to the interior of the root. Why, the very diagnostic condition of the hairs themselves refutes the current opinion, viz., the bent, twisted shaft, due to infiltration by the spores of the parasite at the spot where they break off on attempting to epilate them, and also the white fringing around the orifice of the hair follicle. Much depends upon the stage of disease at which an examination is made; at one time the fungus will not have reached the interior of the hair, at another time the root having recovered itself and the shaft having elongated, the fungus will be found at varying distances in its interior; indeed, sometimes as much as an inch from the follicle, if the hair has not broken off. The favourite seat of the trichophyton is the interior of and around the root, because here not only are the structures delicate, but there is the greatest amount of *moisture*. It is said that in sycosis the fungus never extends beyond the follicle; this is entirely erroneous. I have seen it splitting up the shaved point of the hair, and I possess a sketch, *vide* Plate II., fig. 4, of the appearances presented by a hair taken from the upper lip of a medical man who had been affected for six months by troublesome sycosis; and at a considerable distance, about a quarter of an inch from the follicle, the shaft is seen to be surrounded and partly infiltrated by the spores and mycelial threads of the parasite. Again, in tinea decalvans and tinea circinata, the fungial elements may be detected either in the epithelium, or outside or within the shaft; in the latter case, perhaps only

in the stromal condition. The tendency of the growth of the fungus is towards the papilla, because here there is less resistance offered by the young structures, most secretion, most warmth and protection; but if these very same conditions, but most especially moisture, present themselves in other spots, there will the fungus flourish also. And thus in favus, the secretion being general, the development of the parasite is general, and so on in the manner before indicated, and there is no surer way of helping on the growth of fungi than by the application of moisture and heat—*ex.*, poulticing; for although it detaches the external scabs, crusts (and cups if there be any), it certainly favours the rapid increase of parasitic elements more securely and deeply seated, unless the action of parasiticides be conjoined. The dryness of the scalp readily accounts for the ill-developed state of the fungus of tinea decalvans. The interpretation comes home to my mind readily enough, that the variations in the microscopic seat of fungi are those of degree, not of kind, and when looked at from a general point of view, furnish no ground for the distinction of parasites into different species.

5. *Differences in the microscopic characters* of the fungi themselves are features which most consider sufficient marks of the existence of several distinct parasites in the tineæ. Till very recently, micrologists have remained content with two criteria, viz., variations in the size and shape of spores and mycelium. But now-a-days the opinion is fast gaining credit that these are of little value as differential tests, and that the fructifications alone can be relied upon as such. Dr. Lowe, so far as I know, is the only one who has surveyed the group of parasitic fungi as parts of one whole, he being followed to some extent by Mr. Hogg. If we turn to the literature of the subject, there is certainly no want of descriptions of the various parasites found; but when the attempt is made to apply them practically, many will indicate as well one as another fungus, and a feeling of an unsatisfied character is left whenever the theory is tested by the practice. In estimating the microscopic appearances, it is not sufficient that the examination of the few hairs of

a few cases be made, but care must be taken to draw inferences from a large and varied number of examples, for without this it is impossible to trace any relation that exists between the different fungi, and he who cannot afford a vast deal of time and patience must submit to have his conclusions called in question very frequently.

Size of Spore.—Microscopic differences, be they ever so slight, are of great importance, as the rule; but with reference to fungi they are to a good extent of secondary moment, for the presence of heat and moisture in the one case, and their absence or relative deficiency in the other, would at once produce, *cæteris paribus*, a contrast. Comparison must be made between fungi at the same stage of development if the truth would be obtained, for the same sporule may be double the size at the advanced, compared with its early stage of growth. Speaking generally, favus has the largest, and tinea decalvans the smallest cells; but take the measurements usually given of these two extremes, and how little dissimilarity obtains between them, for the largest of the microsporon audouini are greater than the smallest of achorion,—hence little dependence can be placed upon the consideration of size *per se* in the examination, at any rate of the intermediate links, in the attempt to establish the existence of separate fungi.

The following tabular view speaks for itself:—

	Size of Spore.		Breadth of Mycelium.	
Torula	·007	·003 mm.		
Sarcina	·008	·01 mm.		
Achorion	·003	·01 mm.		
Trichophyton tonsurans	·003	·007 mm.		
Trichophyton sporuloides	·002	·005 mm.		
Microsporon mentagrophytes ...	·003	·004 mm.		
Microsporon furfurans	·0008	·002 mm.		
Microsporon audouini	·001	·005 mm.		
Oïdium	·002	·006 mm.	·003	·005 mm.
Aspergillus	·003	·004 mm.	·009	·01 mm.
Mucor	·003	·004 mm.	·002	·008 mm.
Leptothrix	—	—	·0008 mm.	
Leptomitus	—	—	·007 mm.	

In the same variety of tinea, the size of the spore varies considerably, as may be seen from the above. I have seen the spores in tinea tonsurans and sycosis as large (and as

oval) as any of the achorion, and this tallies with the details of the case of Mr. Hutchinson, before quoted; and also with the observations of M. Raciborski upon the same point. An appreciation of the facts of size, taken in connexion with concomitant circumstances, will not warrant the usual division of parasitic fungi into distinct species, but merely the inference that greater size of spore means greater luxuriance of plant; and this view is entirely confirmed by the results of artificial germination. I had in my possession a preparation which exhibited this point to a conclusive extent. It was a hair from tinea circinata, which presented, when first examined, the fungus (trichophyton) in the state of stroma (nuclear form). The development of this was watched into the sporular form, from whence after a time resulted the large (oval) condition of the achorion. There is no absolute constancy, then, in the measurements of any of the parasitic fungi, because of the fluctuation in coincident circumstances.

Shape of the Spore.—This is the stronghold of those who maintain the total distinction of achorion and trichophyton. Originally taught this doctrine, I have learnt that the oval character belongs to any spore developing into or towards the mycelial condition. If the spores be very small, it may apparently be due to the absence of fluid, for oftentimes the small oval cells of the fungus, if placed into any liquid, will become perfectly spherical; but whenever they commence to germinate, take on the oval form. In cases of severe tinea tonsurans, with a goodly amount of secretion, at the height of disease, oval spores may generally be found in or about the root of the hair. I have seen them in sycosis equally well. M. Raciborski (*Medical Times and Gazette*, March 26, 1859,) has detected large oval spores in Plica Polonica, whose fungus is usually supposed to exhibit a perfectly round form.

It is generally admitted, by those who have paid attention to the subject, that little value can be attached to differences in the shape of the spore as indicative of any special fungus; and the results of germination afford additional

proof of the truth of this opinion. Much detail might be added under this head; suffice it to say, that the transition from round to oval may be easily observed in yeast. The oval is that mostly assumed by the spores of the achorion; but the round is equally common, especially if the fungus lack moisture.

It is necessary for the sake of completeness to allude to variations in the aspect of the mycelium. No conclusion can be drawn from its examination in the tineæ that favours the prevailing opinion which regards the several aspects of tinea as distinct in nature. Many consider that large, straight, forked mycelium filled with granules is peculiar to favus; that in tinea tonsurans the filaments are curved, undulated, small, few in number, and contain few granules; and in chloasma, simple, serpentine, not forked; but clinical observation shows that such statements must have originated from narrow observation. It is here, as with all the other instances of supposed distinctive character, the variations are those of degree, not of kind. Mr. Henry Thompson brought before the notice of the Pathological Society, May 6, 1856, some of the trichophyton in which the filaments were large and plentiful.

Simon[1] has failed to substantiate Eichstedt's assertion in regard to the microsporon furfur, for he has "never seen them serpentine, as Eichstedt has described, but commonly running a straight course and divided in a forked manner." This serpentine character is often removed by the artificial addition of fluid, and appears therefore to be due in some measure to dryness. As the formation of mycelium is more perfect, or, in other words, if circumstances are favourable to development, budding at various parts, the endogenous formation of granules which enlarge into sporules, will take place, and in different instances very dissimilar appearances will result from these same processes according to the extent to which they are carried.

There are some minor points which, for the want of

[1] Die hautkrankheiten durch anatomische Untersuchungen erlautert. Von G. Simon. 1848. (pp. 311—12.)

better, have been brought forward as points of distinction; for instance, the spores of the microsporon furfur lie together in little heaps, and Dr. McCaul Anderson believes that he could diagnose chloasma from this microscopic appearance alone, but oïdium albicans and aspergillus present the very same condition, and "local collections" of spores occur in a tolerably well-marked degree in some of the more common instances of parasitic disease, more especially in the local bulgings of the shaft of the hair. If the fungus is well developed, the spores may present a nucleus, and some of the parasitic elements of one variety refract light more strongly than those of another—this is particularly the case with achorion, but not peculiar to any.

There is, then, nothing in the collective history of the tineæ which disallows our looking upon them in the light of a series. Many of the species possess transitional stages between one and another; some, for example favus, are cut off, as it were, by apparently well-defined demarcations. Nevertheless, as before observed, the fungi may be identical *in nature* (though the soil is different) in each case, and the results of germination, so far as they go, prove that they are so. Now, two questions necessarily present themselves: 1. Why does not the implantation of the fungus of one, give rise in a different subject to the characters of some other form of tinea? 2. What are the several peculiarities of soil and the like which conduce to the maintenance of each and every variety of fungus?

Now, be it observed that the fact of being unable to produce one variety of tinea by the inoculation with the fungus of another is no very tangible argument against the identity of the fungi of the two instances, as at first sight appears; still there is no statement which authorities regard more to be relied upon as showing the distinct nature of favus and tinea tonsurans than that which affirms (and affirms with a good deal of truth) the difficulty, nay, some say the impossibility, of producing the favus condition from the trichophyton, and *vice versâ*. Touching only the general view of this question now, and reasoning from analogy, we should

not expect, except in rare instances, to produce, on the human surface especially, the characteristic condition of one phase by the inoculation of a different stage or state. Fungi generally are disposed to continue their already existing forms—*ex.*, the nuclei produced by the rupture of the torula cells, as Dr. Lowe has shown, perpetuate themselves as such *ad infinitum*. Torula and penicillium are identical in nature, according to the highest authorities, and yet it is rare for the first to assume the aspect of the latter, more particularly because its increase mostly takes place by *budding*, which propagates individual peculiarities. The same applies to achorion and aspergillus; hence there is some warrant for imagining that the phase of fungus found in favus would reproduce itself if it took hold upon the surface at all, and that this would happen, even supposing it were to be implanted upon the locality best suited to the growth of the trichophyton; that is, if it grew at all it would grow as favus. The trichophyton would scarcely develope into the achorion except under the most favourable circumstances, and though decisive examples are wanting so far as regards the physical aspect, yet the microscopical history shows very plainly the transitional stages in bad tinea tonsurans between achorion and trichophyton. Though not lacking opportunity, I have not felt myself justified in submitting patients to the ordeal of testing the growth of various fungi upon their surface with the view of determining the question of their relationship; but reasoning *à priori*, it would appear that the conditions most favourable for the production of favus from tinea tonsurans would be the implantation of the trichophyton tonsurans upon an already existing impetigo, or the like, in a strumous subject of early age. There is no difficulty whatever with regard to the minute, but only with regard to the external characters of the tineæ, in tracing their affinity; but, as before observed, when we come to discuss the question, the argument drawn from the fact that the implantation of the fungus of one does not give rise to the external characters of another variety, has little significance. And in like manner, tinea tonsurans we should scarcely

expect to produce, by the inoculation of the fungus of tinea decalvans; the concomitants of the one are not suited to the occurrence of the other by the transmission of the fungial elements. Though there can be no doubt that in a general sense there is much truth in this opinion, yet, on the other hand, we are not in want of *clinical evidence* to show that the implantation of the fungus of one may cause another variety of tinea. We see at times the several members of a family curiously affected—some are the subjects of tinea tonsurans, others of tinea circinata; the father may have sycosis, the child tinea tarsi (examples will be adduced presently); it is indisputable that the several varieties in many of these distributions of tinea may result from contact with one original form. To sum up, *secretion* means suitable pabulum—this favours the increase in the *amount of parasite*, and conduces to *rapidity of growth*; differences in the *seat* and *microscopic* characters of the fungi are to be explained in perfect harmony with fluctuations in the degree and kind of the above conditions in the way we should be led to anticipate. The presence of sebaceous glands modifies the aspect of sycosis; the character of the perspiration, that of tinea versicolor; the peculiar blood state leading to glutinous exudation, that of tinea polonica; the absence of activity, that of tinea decalvans; the fit state of pabulum and consequent luxuriance of parasite, that of tinea favosa; the activity of fungus and comparative deficiency of secretion, that of tinea tonsurans; in the latter, the fungus seems to absorb, as it were, all the available moisture. At the present time, our knowledge will not enable us to define with any very great precision the particular conditions of blood-state which conduce to the maintenance and production of the several tineæ; however, there are certain tendencies in each which have been more or less noticed in the early part of the subject, and it appears to me that medicine has much to teach us on this score before we shall be in a position even to *experiment* with any degree of satisfaction.

CHAPTER XI.

Clinical and Experimental Evidence.

The prominent features exhibited by the tineæ have thus been briefly criticised, with the view of showing how questionable it is to consider parasitic diseases and their fungi as essentially and severally distinct in nature, by the usual means of test. There now remains for discussion the evidence afforded by clinical and experimental observation. The succeeding remarks will apply more especially to the relations of the fungi themselves. It has been said that it is a matter of little moment as to whether research shall prove the fungi to be or not to be identical; but this I think a manifest error, and a matter of more than mere scientific interest. If the parasites be mere variations of one common form, our treatment is simplified, and becomes a question of *degree* only; if, on the other hand, there are distinct parasites growing upon the surface, we are very likely to be led to the employment of different methods of treatment in the several tineæ; besides, in the former case we are justified in reducing our therapeutical operations to, and basing them upon, one general plan. Again, we have an argument *à priori*, showing that the soil is the same *in kind* in every case, and have merely to *modify* our general treatment to meet the particular *modification* of nidus in each instance.

Tinea Favosa and its Relations.—Tinea circinata affords a very suitable nidus for the growth of the achorion. I well remember Dr. Jenner telling his clinical class, some years since, that at one time was admitted into the Children's Hospital a case of favus, and for a long time no one caught

the disease, though the children played together. Now the fact, as here stated, is apparently a strong argument against the contagiousness and in favour of the essentiality of favus; but it must be remembered that the achorion required a fit soil, and would only perpetuate itself in its usual form, refusing to retrograde and become a less developed condition. It so happened that, some little time after, in came a case of "herpes circinatus," which spread to two or three others, and of these, two became affected with favus implanted upon the patches of herpes. There is no difficulty in arriving at the just interpretation of these occurrences. The phase of fungus in tinea circinata was capable of growing where the achorion could not, and the latter could take hold upon *pre-existing eruption* which presented itself in the "herpes circinatus." If it be asked why did not tinea tonsurans result from the implantation of the achorion upon the tinea circinata, I can only answer that fungi are wont to perpetuate themselves (as before observed) in already existing forms. The torula cell in one example buds, in another enlarges with endogenous formation of nuclei, and in another takes on the mycelial condition, with the formation of tubes of peculiar and different aspects; in each of these and like cases, the tendency is to continue the special mode of formation and increase which obtains at the outset, and in consequence, *variations* only, of the same fungus have been looked upon and classified as separate *species*. Dr. Hillier (*British Medical Journal*, Nov., 1861) asks, if the achorion and trichophyton are the same, out of twenty-five cases, many of the worst kind, which came under his notice at the St. Pancras Workhouse, is it not probable that some would have gone on to favus? Possible rather, I would say, but not highly probable. If two hairs, the one from tinea favosa the other from tinea tonsurans, be "put up," and the fungi germinate, the resultant mycelium and chained condition of spores will be found in many specimens to exhibit complete similarity; in other words, the fungi exhibit no distinctive features. If two heads, the one favus the other tinea tonsurans, be poulticed, and thus cleansed from scabs and secretion and such

like, little difference is seen on comparing the two together, especially if the scalp be shaved; but nothing has been removed but the excess of fungus and secretion in the one case, and the twisted state of hairs (due in part to dryness) in the other; and could the trichophyton be made to grow apace, with an increase in its fringing around the follicle, what would there be to distinguish it from the favus cup? The question, then, which occurs is just this—Are there any conditions which accompany the cases in which favus occurs and which are absent in those of tinea tonsurans? I have been watching very closely of late an instance of favus of some twenty-five years' standing, in a strumous subject. The scalp, when left to itself, became covered over its entire extent with fully-developed favi; after treatment had been carried on awhile, these gradually became less extensive, and presently the disease changed its character to a marked extent. Instead of regular favi, the separate spots corresponding to the hair-follicles assumed the appearance of the component parts of sycosis, the hairs pierced a yellow circle seated upon an inflamed spot, which circle was composed of effused fluid and fungus elements, and this always preceded the formation of favi; the only difference between this early stage and sycosis was the absence of any very distinct indurated base, probably due to smaller size of the sebaceous follicles of the scalp. I possess a drawing, made by a careful artist, of these appearances, and the similarity to the condition of sycosis is quite decided, to say the least.

My notes say, "If we could transfer certain parts of the disease in this case from the head to the chin, I am confident that the opinion which most men would immediately come to would be that sycosis existed. In another instance of long standing tinea favosa, which is getting well, there is nothing to diagnosticate it as favus; there are bald patches here and there, the hairs are 'tonsurant,' loaded with oval and round spores, the surface covered with furfuraceous scales, but the same peculiarity exists as in the other case; the hair is surrounded at its emergence from the follicle by a yellowish mass made up of epithelial scales, effused fluid,

and fungus elements, and which cannot be called 'a cup.' It has an exact resemblance to that condition which results in severe tinea tonsurans from the free growth of the parasite in a more than usual amount of secretion, produced generally in consequence of irritating applications which are not sufficiently powerful to destroy the fungus itself. Such a crust differs in the fact of its being more superficial than the cup of favus, among other minor points, though there is a decided similarity. Now, the two cases are both connected with the scrofulous diathesis; and looking to the detail of these as compared with others of a different grade, it appears to me that where favus occurs there is a peculiar secretion poured out into the follicle, in which the fungus speedily and markedly increases to the extent of producing favi, because the very best pabulum is present. In tinea tonsurans secretion, especially that peculiar kind noticed in case of favus, is absent; and in consequence the fungus never reaches to such a state of growth as to produce a decided cupped crust."

I am thus anticipating certain objections; it will be said, but why does not the implantation of the achorion upon the tuberculous subject give rise to tinea tonsurans? Perhaps too much stress is made upon the diathesis. I mean to imply that in those cases in which favus occurs there appears to be a condition of system which is different from that present in those attacked by tinea tonsurans, and that the former appears rather in conjunction with struma, and the latter with the development of tubercle. Be that as it may, the objection just noted carried nothing but plausibility with it. The achorion will not, as a rule, develope unless it finds its own peculiar nidus (possibly it may co-exist with the tuberculous crasis); whatever it is, it is other than that suited to the trichophyton. But, even supposing the latter did support the vitality of achorion—inasmuch as fungi reproduce their prevailing forms—favus would rather result, and not tinea tonsurans, unless the process were repeated once or twice. Moreover, it is no argument that bad tinea tonsurans does not pass on to the condition of favus, because

the latter would result at once if a fitting state of soil were in existence. The whole subject is open to experiment, though it will be a long time before anything definite can be obtained, on account of the rarity of necessary conditions. If a favus patient could be cured, and then the fungus of any other variety of tinea implanted upon the surface, some tangible result might be obtained. There is a pretty good amount of evidence to show that chloasma may be produced by contact from tinea tonsurans, the latter from tinea circinata, and *vice versâ;* but very little opportunity of testing mutual inoculation is to be obtained in the case of favus. The only clinical fact that has come under my notice was observed in one of the two cases before referred to. On one occasion, after shaving the head, and I suppose letting a good deal of the fungus fall upon the neck and shoulders, a number of little bright rings made their appearance in the latter situation, and instead of passing on to the state of favi, simply faded away and left behind for a few days a branny incrustation. Now, had there been heat and *moisture* present, and a goodly number of hair follicles, most probably the same disease as that of the head would have resulted. It is of consequence to mention that favus had, some long time before, attacked the general surface of the body in this very case; but on the present occasion the patient was under the influence of arsenic, and a somewhat exaggerated form of tinea circinata occurred. The patient had been perspiring a good deal.

Dr. Lowe has met with an example of a somewhat similar kind (*Lancet,* Oct. 29, 1859); a patch of favus during cure passed into tinea tonsurans, himself being attacked at the same time with "herpes circinatus."

Hebra believes that tinea tonsurans and favus are different stages of one disease, and his second plate (*New Sydenham Soc.*) represents the combination in the same subject, as he thinks, due to the same cause. Dermatologists believe, partly from their concurrence, the identity of tinea tonsurans, "herpes circinatus," and sycosis, and it is only fair to allow Hebra the use of the same argument, but Dr. Ander-

son, referring to this matter in opposition to Hebra's view, remarks, "there is no reason why a patient may not be attacked by two fungous growths at the same time, and besides, such cases are decidedly rare."

Bazin admits the difficulty of distinguishing accurately between tinea scutulata (a variety of favus) and bad tinea tonsurans, which has been considered.

The upshot of the matter is this; that the achorion, even if identical in nature with other epiphytes, cannot be expected to produce by inoculation upon the human surface any variety of tinea other than favus except as the rarest phenomenon, and inasmuch as it is the most developed condition of fungus in which the spores become nucleated, budding is apparent, and fructification attempted, the soil which suffices for other phases will not conduce to the retrograde growth of achorion, which has the tendency (alike common to fungi) to reproduce itself. Moreover, in the decline of favus, the aspect of tinea tonsurans is portrayed; that it would help the solution of the question of the relation of favus and other tineæ if the attempt were made to produce the former by implanting the elements of different fungi upon a patient in whom tinea favosa has just been eradicated; that in the case of favus there is a peculiar secretion poured into the hair follicle (especially) by the tissues around, which is dependent upon a peculiar blood state, closely related to struma, and in, and at the expense of which, the achorion rapidly increases, so as to produce the cupped favi; that transition stages representing other varieties of tinea are not assumed by favus because the local conditions (*ex.*, secretion) are such as help out the full disease at once (tinea tonsurans is dry compared with favus, which in outward aspect has more resemblance to sycosis, in which secretion is markedly present, and wherever moisture is present the development of any fungus is rapid); that the peculiarity of the soil of favus is seen in the convalescence of the disease, for "secondary symptomatic eruptions" are very frequent—not so in tinea tonsurans and other varieties. The same is seen in the commencing stage of favus; there

is an accumulation and increase of the cells of the part, presently assuming the aspect of an exudation, at the under surface of the epithelium at the orifice of the hair follicle; this, again, is not so marked in tinea tonsurans, but whatever the secretion is, the fungus increases rapidly at its expense in favus.

Such are the legitimate inferences deducible from a study of the clinical history of favus and the habits of parasitic fungi which the present insufficient state of knowledge allows; and they show that there is no ground for rejecting the identity of Tinea favosa and T. tonsurans in our inability to produce artificially the one from the other except but very rarely.

There remains another mode of investigation in tracing the relation of parasitic diseases, viz., the artificial germination of their fungi. It is clear that an identity in nature will be established if from the spores of the several different tineæ the same fructification results. Still there are a few who even go so far as to deny this, and only become convinced when the original forms are reproduced from the common fructification. Happily this can be established in regard to many of the varieties of tineæ.

My observations upon the artificial growth of achorion were anticipated by Dr. John Lowe (on the Identity of Achorion and other Parasites with Aspergillus Glaucus).

On the 1st of February, 1857, Dr. Lowe divided some favus matter into three portions. No. 1 he put into glycerine, and after ten days found no attempt at germination had taken place, but a granular homogeneous mass remained; the fluid was kept for a month without further change. No. 2 was placed on cheese with the same result. No. 3 "was put into a saccharine solution. In forty-eight hours the cells became swollen, and the majority of them assumed an oval form; some, however, remained spherical, were slightly increased in size, and resembled yeast-cells." On the following day the cells had joined together, and mycelial beaded threads had been produced; at the end of a week short jointed tubes were seen.

On the ninth day some of the cells put forth filaments or processes. On the sixteenth, the whole mass had become filamentous. On the twenty-seventh, the tubes contained spores. On the thirty-sixth day the fructification appeared, and was recognised as that of aspergillus glaucus; subsequently to this, sacculated moniliform tubes were produced with endogenous formation of nuclei.

Dr. Lowe insists upon the complete resemblance between some of his own germinations and the figures of Robin, Plate III.—13, representing favus growing on apple; he thinks that the cells seated upon the receptacles are not true spores, but gemmæ (in opposition to Mr. Berkeley), which go to form mycelium, and are analogous to the prothallium; whilst the large and small cells developed in the tubes represent the antheridia and pistilidia of ferns, the former being the true reproductive bodies. Remak obtained, on the third day, penicillium on an apple upon which he had placed achorion to germinate, but drew a negative inference.

In experimenting upon this subject I have been very careful to compare together fluid with and fluid without the achorion in it, and sometimes have left these exposed to the air, with the exception of a light covering, at other times have put them up as ordinary preparations; in the latter case it is only very rarely that the fungus can be made to germinate freely.

This is what takes place. At first there is a junction of spores, and from this results the mycelium, which is formed by the enlargement of the original cells and subsequent budding; at certain parts the filaments enlarge unequally, so as to produce dilatations or sacculi, or if at their terminal ends, clavate heads full of spores; endogenous formation of sporules goes on, and by and bye the enlargements burst and give out the contained spores, which collect together in various ways, generally in little heaps entangled in the interlacement of fibres. The clavate heads (the terminal cell) may be given off wholly and repeatedly, while the formation of cells in the interior may still continue till the parent cell ruptures also; it is by no means uncommon to find the

ruptured sacs in the vicinity of little heaps of spores. In some instances, large cells may be seen apparently putting forth processes; I say apparently, because many cases are in reality a terminal enlarged cell with part of its mycelial filament attached. The fructification consists of a collection of spores around or upon what is called a receptacle, which will be noticed in speaking of aspergillus; *vide* Plate IV. fig. 4.

There are yet a few points in the history of favus to be glanced at. Bazin, in his work, mentions the case recorded by Dr. Draper, of New York, of a family attacked by favus, which was communicated from a cat (that had played with the children) after eating mice affected with the disease. I am indebted to Dr. Woodman, of Stonehouse, for the following:—Giuseppe G——, æt. 19, a fair *strumous* Italian, who looks far more like a German, a native of Milan, admitted in the London Hospital, October, 1861, for strumous disease of the great and adjoining toe of the right foot, apparently the metatarsal and first phalangeal bones. His light brown hair was of considerable length, pretty thick, and so disposed that he had been in the hospital some days before the favus patches on the top of the head were noticed; there were three about the size of sixpences, and some smaller ones. There was no doubt about the diagnosis, for the smell and microscopic characters were all confirmatory. The disease had existed eleven years. The brother had it first, and the two slept together; they kept white mice, which were "scabby." The patient had no idea that he caught the disease from the mice, but is quite sure he and his brother had the white mice before their heads were bad. Several doctors have tried to cure them.

I extract the following from Dr. Lowe's pamphlet. "Brewers, generally speaking, are not likely subjects for the growth of parasitic plants, but I have met with several cases which seem to me to prove that these are derived from the growing yeast. In one brewery I met with two cases of lichen, amnilatus solitarius, and one of sycosis. They occurred in the only persons engaged amongst the yeast. I

have recently met with another case of like nature; namely, of favus occurring in a person engaged in a wine vault which was densely covered by fungi. The former were situated in the right upper extremity, in the one case on the back of the hand, in the other about three inches above the wrist, on the back of the forearm; the sores commenced as small red spots, and in eight days attained the size of a shilling; on examination under the microscope, a distinct mycelium was obtained, differing in no respect from the same growth in favus."

Of this much I am confident, that in favus there is a peculiar blood state (a modification of the strumous diathesis), which evidences itself, among other things, by the pouring out into the follicle of an exudation in which the parasite flourishes, and this change is accelerated by the irritation of the parasite. The nature of this local state is not very clear; the fluid, which is at first quasi-gelatinous, but soon becomes milky and thick, is frequently seen when the little operculum which often forms over the follicular orifice is removed. The formation of the favus crust absorbs it, consequently it is most abundant at the early stage of disease, or rather, when the cups are just reforming. The consecutive secondary eruptions which follow convalescence in favus are evidences of the pathological condition referred to above, which probably plays the chief part in differentiating the aspect of favus as compared with that of other tineæ.

Tinea Tonsurans.—Enough has been said under the last head as to the relation of tinea tonsurans and tinea favosa. Most of the leading foreign dermatologists regard the identity of tinea tonsurans, tinea circinata, and tinea sycosis as beyond dispute; and in England there is at the present time a strong bias towards the same conclusion, associated, however, with great disinclination to handle the subject of the identity of parasitic diseases, to which, comparatively speaking, little attention is paid, and of which but little is thoroughly understood by the profession at large. Bazin's view has been accepted by Dr. Anderson, to whom I owe an apology for an unintentional injustice in accusing him of adopting, without

due acknowledgment, the opinions of the former observer. The three above-named diseases are considered identical in nature (different stages only of one and the same disease), for three chief reasons:—

1. That the same fungus is found in all of them.

2. That these three maladies are found together upon the same person, more or less frequently, in different combinations, and one variety can be produced from another.

3. That in families, while some are attacked by *this*, other member or members are affected with *that* variety, there being an entire absence of any separate cause in the several instances.

The first proposition is a necessary inference drawn from microscopical examination, and its truth is confirmed by the results of the artificial growth of fungi, as will presently appear. The concomitance which the second proposition affirms is by no means rare, and is allowed by the majority of those who are paying particular attention to the subject of skin disease. Of those subjects affected by tinea tonsurans the presence of tinea circinata may be looked for in about a fourth. Dr. Hillier found the coincidence in 10 of 27 cases which were together in the St. Pancras Workhouse, under the same modifying influences. Tinea circinata, under such circumstances, is usually seated on the neck or shoulders. I have seen it travel both to and from the scalp, becoming modified in its transit, and the one may assuredly produce the other in the same subject in this manner. If tinea tonsurans travel from the head to the neck, face, or forehead, tinea circinata results; but if the latter travel upwards to the scalp, tinea tonsurans may be produced, showing clearly by this crucial experiment of nature's own making, that difference of seat which involves variation in the amount of hair follicles more especially, accounts for the dissimilarity in the external characters of some of the tineæ. I have never seen the coincidence of true tinea tonsurans and tinea sycosis, but have met with a case in which sycosis and tinea decalvans were conjoined. We should certainly expect this latter co-existence, because of the influence of age in determining

the occurrence of tinea tonsurans generally at an early age. I saw, not long since, however, in Mr. Hunt's practice, the combination of tinea decalvans, tinea sycosis, and tinea tarsi in the same patient.

Tinea tonsurans may give rise to tinea circinata by the implantation of its fungus, not upon the surface of the same, but that of another person, as in the case of Mr. Hutchinson (*Medical Times and Gazette*, Jan. 12, 1860). Bazin has recorded evidence to the same effect, the father and daughter becoming diseased by tinea circinata, which the former had caught from some horses affected by tinea tonsurans, which Bazin examined himself, so as to set aside all doubt. The father (a dragoon) stated that five or six comrades were affected in like manner; and it is very interesting to note that the characteristic effect of tinea was perfectly developed in the case of the man who presented himself to Bazin, for he had *alopecia* of the forearm where the tinea circinata existed.

I have known tinea tonsurans give rise, by transplantation of its fungus, to sycosis; this, however, is uncommon.

Proposition 3 is by no means unsupported by fact. I know two instances of families the children of which were affected by tinea tonsurans, and the fathers by sycosis, and in one case the grandmother by very marked tinea circinata of the wrist, so that in one of these cases, the three varieties of tineæ now under consideration existed separately, but were evidently due to one and the same cause. But very recently I have seen three members of another family in whom the following combinations were present: in No. 1, T. tonsurans and T. circinata of the face; in No. 2, T. tonsurans and T. circinata of the shoulder; and in No. 3, T. circinata of the face only.

I know well enough that an objection will be raised against the interpretation put upon these facts; it will be said, Is it not possible, and indeed probable, that in the above instances, in which one variety of tinea co-existed with, or appeared to be produced by another, instead of one, two or more (according to the number of coincident dis-

cases) distinct fungi existed? This opinion must give way before the results of germination, and I therefore do not attempt to multiply clinical illustrations of identity, but pass to the consideration of the artificial growth of the trichophyton, which will clear the way for a general summary of the relations of all parasitic fungi. Experimental research in this subject requires most patient perseverance, and there can be no doubt that medical men are unable, as the rule, to undertake the investigation, inasmuch as so great an amount of time is consumed, if fallacies would be avoided, even in carrying out the most trifling experiments. In two only out of a very large number of experiments have I succeeded in germinating the trichophyton and producing results such as thoroughly satisfied me in regard to truthfulness and the avoidance of error. The method employed was that ordinarily had recourse to in "putting up" microscopic preparations, and the rare occurrence of fructification is probably to be ascribed to the exclusion of air. The liquid media used have been glycerine, acids, especially the acetic, weakened, and liquor potassæ. In one case aspergillus, and in the other the quaternate form, resulted. In the middle of 1859 I put up a hair or two from a bad case of tinea tonsurans, in water to which a little liq. potassæ was added. The hairs were atrophied at the roots, and the stem was pretty well loaded with spores. No change took place for some time, with the exception of some increase in the parasitic elements, both as regards size and number; presently, the fibrous part of the hair became more open, and this at length was seen to be due to the growth of the spores, their junction, and the formation of mycelium, which commenced to sprout from the hair into the surrounding fluid. About this time I went into the country for a week or so, and my preparation became mislaid, very much to my regret; however, as it subsequently turned out, it was carefully placed amongst other microscopic slides, in safe keeping, and in the following January (1860), that is, at the end of six months from the time it was originally "put up," I found, on examination, that the fungus had grown downward among the

fibres, and had split up the root, from whence a large mass of mycelium ran away, forming "moniliform chains" (beaded) composed of cells, many of which were nucleated. The possibility suggested itself that this growth might have been derived *ab externo;* but then the preparation was hermetically sealed, the mycelium was all the same in kind, and there were transitions between it and the cells within the shaft of the hair; the production of the one from the other was noticed when the specimen was first under notice. Then, again, there was no fungus running in towards the hair from the circumference of the fluid. In examining the starting point of the growth, the spores were found to be oval and chained, indeed an exact condition of achorion in an early stage of development was present; the smaller cells of sporules, or rather granules, had enlarged into true spores. Tracing the mycelium outwards, the chains of cells became enlarged, less beaded in appearance, the walls double contoured, and containing large round cells. Budding from the different angles took place so as to form secondary threads, and at the terminal ends of five of these latter, the spores were arranged exactly in the same manner as in aspergillus glaucus. On searching with a high power very carefully, a few tubes of the mycelium known as mycoderma were found stretching from the side of the hair, which had no doubt travelled across the field by continued budding. In April, 1860, the condition of things was pretty much the same, more budding was apparent, and the number of spores in the hair had increased; the granular stroma had developed in great part into sporules. My notes say, "the receptacles of the fructification are rather short; over the field is a fine tubed mycelium, like the 'mothery' of infusions, and there are a few large free round cells, two or three apparently putting forth mycelioid filaments." One of the interesting points worthy of notice is the fact that the trichophyton in its growth to reach the aspergillus passed through the stage of achorion.

In consequence of some other results that I had obtained in germination, I determined to attempt the production of

other forms of fungi from the spores of the fructification in this case, which appeared likely to be accomplished by the addition of some fresh fluid and a little air. I purposed, having done this, to sketch the appearances at starting (for I had made no drawing before); however, notwithstanding the exercise of the greatest care, the re-application of the black varnish completely destroyed my whole year's work. As yet I have not succeeded in producing again the perfect fructification of aspergillus, but only the sacculated condition of mycelium which precedes it. In all these artificial growings, a striking feature is the very slow pace at which any change takes place; sometimes several months, and even years, will not suffice to bring about any decided modification. This is most probably due to the withdrawal of the influence of the atmosphere. In all the cases that I have seen, the increase in the growth of the fungus is accompanied by a fatty degeneration of the fibres of the hair; and with the chained condition of enlarged spores there is present a greater or less amount of fat, crystallized out either in acicular crystals or little radiate tufts, which give a beautiful appearance when examined with the polariscope.

The facts in connexion with the germination just described show (1) that the granular stroma is only an early condition, and is ample evidence of the presence of a parasite; (2) the identity of achorion, aspergillus, and trichophyton. (Under the head of sycosis, reference will be made to the production of the quaternate form from the trichophyton.)

Tinea Circinata.—The relations of this variety have been in part considered. It forms a favourable nidus for the growth of achorion, and, as before stated, tinea favosa may be associated with tinea circinata of the general surface of the body, produced by inoculation with the germs of the achorion derived from the head. In this statement I am confirmed by the experience of Dr. Lowe, who was attacked by T. circinata from contact with a favus patient (*Lancet*, 1859). I have seen it associated with T. decalvans and T. sycosis in the same subject, though it is by far most frequently found conjoined with T. tonsurans; and, as Dr.

Jenner has remarked, it very frequently travels from the forehead, and appears to become identical with the latter. The following is a case in point:—Mrs. F. came to me, April 15th, 1859, with patches of "herpes circinatus" on the face, made up of well-defined rings, which exhibited ill-formed vesicles, and enclosed a branny centre. The magnifying pocket-glass showed that the hair follicles were especially involved: there was one patch underneath the left eye, one above the outer angle of the left eyebrow, two on the left side of the forehead, and one large one on the right forehead, with several smaller ones. The patient had been "ailing" for some time; was pale; the appetite was bad. When under examination, she fainted; and as the blood disappeared from the face, the patches became of a dull amber colour, very much like tinea versicolor (chloasma). On placing the hairs and epithelium under the microscope, the sporules of the trichophyton were detected. Sulphurous acid lotion was prescribed. 17th. Spots better. 21st. To-day, complained of itching of the head, and the scalp along "the parting" looks here and there erythematous, and little elevated patches, the size of two pin's-heads and more, are seen, and through the centre of each a hair runs out. There are six distinct spots of the kind; the cuticle is upraised, the hairs are bent, one or two broken off. On the forehead are one or two little spots, of the circinate form of tinea, leading up to the scalp, and becoming altered in aspect in the manner just described. I allowed the disease to run its own course until the character of tinea tonsurans had become well developed, before adopting any treatment. The patient's age was 28. The examination of this case occupied a considerable amount of time on several occasions, and in using the pocket-glass my face was kept pretty near the forehead, where the patches of tinea circinata were. Now, it so happened that at this time some vesicles of herpes (phyctenoid) on my upper lip were just dying away; but suddenly the lip became very painful and tense, a thick secretion was poured out, and shaving at the same spot became very disagreeable. I never suspected at the moment that any transplantation of fungus had taken

place, but, extracting the hairs and examining them with the microscope, to my astonishment proved such to be the case, for the spores of the trichophyton had actually split up the shaved ends, and were making their way down into the follicle. I need not add, that I quickly applied a strong solution of bichloride of mercury, and so in a little time got quit of sycosis.

"A few weeks since," says Dr. Hillier (*Brit. Med. Jour.*, Nov. 23, 1861), "I met with a case in which a girl, sixteen years old, had a patch of herpes circinatus on the smooth part of the forehead at a time when no other case of ringworm was known to exist in the building. This was followed in about a fortnight by a round patch of tinea tonsurans on the vertex. When I saw her the patch had attained the size of half-a-crown piece; the hairs were broken off short, some of the fragments being white and powdery, others dark and thickened. Microscopic examination revealed minute sporules, 1-7000th inch in diameter." The coincidence of the two, T. tonsurans and T. circinata, Dr. Hillier correctly judges, "can be most easily explained by supposing them to depend on a common cause." Dr. Jenner entirely dissents from this opinion, for the following reasons:—

1. It is only now and then that the trichophyton is found in the scales of the furfuraceous variety of herpes circinatus seated on the trunk.

2. This variety of herpes is sometimes seen on the scalp, presenting characters identical with those it exhibits when seated on the trunk.

3. A disease of the scalp, which at its commencement differs in no particular from herpes circinatus, may in its progress assume all the characters of tinea tonsurans.

4. At the margin of tinea tonsurans are found vesicles, or the remains of vesicles.

5. Patches of tinea tonsurans are seen, which from first to last have no trace of vesicles, and the margins of which in no way differ from their centres.

6. While patches of herpes circinatus are cured by local means, the patches of tinea tonsurans are unaffected by the same means.

From these facts the following conclusions seem inevitable, adds Dr. Jenner:

1. That herpes circinatus and tinea tonsurans are distinct diseases.

2. Tinea tonsurans owes its peculiar character to the presence of a vegetable parasitic growth.

3. The secretion of herpes circinatus forms a favourable nidus for the growth of the trichophyton. (*Medical Times and Gazette*, November, 1857.)

I have the most implicit confidence in any and every opinion of Dr. Jenner, not only in that he was my teacher, but also because I find his general teaching and doctrine more and more confirmed by increasing experience. Now, there is nothing which Dr. Jenner encourages in advanced students, or those who have mastered the groundwork of medicine, so much as the habit of thinking out matters for themselves in accordance with clinical facts; and I therefore venture to differ from him in the present instance, necessitated by my own observations, but diffident nevertheless in the power of my own abilities to comprehend the true position of the question, as stated in the propositions above quoted. And the following form the pith of the objections which may be raised against the latter.

Firstly, it is said that tinea circinata is often unaccompanied by a fungus. Admitting the fact of our inability to discover the trichophyton in all cases, it appears to me that the absence can be readily explained. In many cases the fungus dies out before an examination is made. Then again, the parasite is missed from want of sufficient care; the epithelial scales should be scraped off the diseased patch, and with some of the downy hairs placed upon a slide in a little weak liq. potassæ, and allowed to soak awhile, when the fungus will be frequently detected. Again, the granular (stromal) condition of fungus is quite sufficient to account for much of the mischief present; and this state of parasite is always overlooked. The fungus may be left behind in the follicle, or it may be carried up on the shaft of the growing hair. The spores, as in tinea decalvans, are very small as a rule. I have usually detected the mycelial form of the trichophyton.

Secondly. "Herpes circinatus is seen sometimes on the scalp, presenting characters identical with those it exhibits when seated on the trunk." This condition I have seen pass on to tinea tonsurans; or, to put the case more fairly, so-called "herpes circinatus" may travel from the face to the scalp, and there commence with minute vesicles seated upon an inflamed base, but presently assume all the characters of tinea tonsurans, as expressed by the third proposition of Dr. Jenner, thus—"A disease of the scalp, which at its commencement differs in no respect from herpes circinatus, may in its progress assume all the characters of tinea tonsurans." I scarcely see how the acceptance of the conclusion that the two diseases are identical can be avoided; the microscopic appearances are certainly alike in the two cases, as I have myself proved.

The next two arguments made use of by Dr. Jenner, viz., the presence of vesicles, or remains of vesicles, sometimes at the margins of patches of tinea tonsurans, and the existence of other patches possessing no trace whatever of vesicle, apply also to tinea circinata, though it is certain that vesicles exist generally in the latter case, but may, as in tinea tonsurans, disappear, and be apparently absent. So much depends upon the condition of the system, the parasite in one case will cause erythema with subsequent desquamation only, and at another time well-developed vesicles.

Lastly, it is affirmed that while patches which offer only the characters of herpes circinatus are easily cured by simple applications, the patches which are distinguished by the signs proper to tinea tonsurans are altogether unaffected by the same means. This is certainly true as a general rule. Tinea circinata is not a deeply seated disease, the hairs are few and small; in tinea tonsurans the fungus after a time gets imbedded deeply in the well-developed follicle of the scalp, and is difficult of access; hence the variation in the efficacy of local means in the two cases, which, however, under similar conditions, are both equally amenable to treatment, and from repeated trial I have no hesitation in saying that a single application of a parasiticide will cure

many cases of tinea tonsurans in an early stage, or, what is the same thing, when the fungus is as easily reached as in tinea circinata. The production of the one from the other is so distinctly proved by clinical evidence, that no doubt can be entertained of the identity of tinea tonsurans and tinea circinata, as far as I am allowed to be a judge. I have been very unsuccessful up to the present time in my attempts to germinate the fungus of tinea circinata. In one preparation which I put up, February 28, 1859, the granular condition of parasite grew very slowly, and in the beginning of 1860 many of the minute sporules had become enlarged, oval, and granular, indeed exactly like achorion in all respects; at the present time they are beginning to form tubes, there being one piece with three joints. I have seen the mycelial threads in tinea circinata very well developed in the early stages of disease, and on one occasion the terminal point exhibited a distinct clavate and rounded head, which is seen in Plate II. fig. 2, showing the analogy to the fructification of the common mould, of which I have no doubt the specimen in question was an early and ill-developed condition.

Tinea Sycosis.—There can be no doubt that this is a modification only of the more ordinary form of tinea seen on the scalp, and there is certainly very good reason why it should differ in its aspect from, though it be identical in nature with, tinea tonsurans; for the glandular apparatus connected with the secretion of sebaceous matter is very markedly developed in those parts where tinea sycosis is found. I have called attention before to the similarity manifested by favus during its arrest and cure towards T. sycosis, and have in my possession a drawing which exhibits this point very clearly, the acuminated pustule-like heads being found, on microscopical examination, to contain parasitic elements, and a homogeneous mass, interspersed here and there with epithelial scales, fatty matter, &c. I have also detailed a case under the head of tinea circinata, in which the latter gave rise to inoculation to T. sycosis. The converse of this is easily established. Tinea circinata of

the wrist and back of the hand may occur in connexion with tinea sycosis, "owing," as Dr. Anderson observes, "to the patient rubbing the itchy and diseased portions of the chin with these parts (wrist and hand), and thus causing transmission of the parasite." This conjunction, as cause and effect, I have, however, only seen once, so far as I remember. Instances are not wanting to show that T. sycosis may result immediately from and as a consequence of tinea tonsurans, and Gibert ("Traité Pratique des Maladies de la Peau," &c., tom. i. pp. 278, 279) is quoted by Dr. Anderson as establishing this point. Under the head of tinea tonsurans some instances of coincidences were stated which help to establish the close relationship of the more ordinary forms of tinea; one of the cases was that of a family, some of the children of which had tinea tonsurans, whilst the father was attacked by sycosis. In another of the examples, the children had tinea tonsurans, the father sycosis, the mother and the grandmother tinea circinata. In a third instance, to which casual reference has been made, tinea decalvans, T. sycosis, and T. circinata co-existed in the same subject.

Dr. John Lowe, in his pamphlet, has given good reason for supposing that the implantation of the yeast plant may give rise to the occurrence of T. sycosis.

If reference be made to Küchenmeister, an opinion is expressed "that the mentagrium of Martial (Epigram. lib. xi. 98), and the pudendagrum of Pliny, with its formation of little knobs and tubercles, was nothing more than the consequences of the microsporon mentagrophytes being carried by the Roman 'Libertines,' called Cunnilingi and Basiatores, from the chin to the genitals, and from the genitals again to the chin of a third person." I have never seen a case of so-called *Chinese ringworm*, but from what I have heard (from an eye-witness) of the disease, it appears to me exceedingly probable that this affection, which attacks the genitals and neighbouring parts, is nothing more than a form of T. sycosis.

I mentioned having seen, in one instance, the micro-

sporon mentagrophytes in full development upon the diseased shaft of the hair, some way from the follicle. Now, in this instance, the spores were oval, nucleated in connexion with a chained piece of mycelium, the aspect of the whole differing in no way whatever from achorion.

The only artificial germination that I have succeeded in producing is that of the fungus from "lichen pilaris," or sycosis, within the nostril, which might have been either trichophyton or microsporon, so far as I could tell from microscopic examination. On Feb. 26, 1860, I put up a diseased hair taken from the nostril in liq. potassæ. March 2nd, an increase in the number of spores had occurred; many have become oval, and in addition, a goodly number of Rainey's concretions (carbonate of lime) have made their appearance; in addition, here and there are double contoured cells, in size about that of blood corpuscles, grouped in fours and fives, and in little chains of five, six, and more, resembling the moniliform chains seen in the development of achorion. There were also one or two quaternate spores, evidently resulting from the junction of separate spores, and *quite distinct from the "concretions."* March 6th, granular appearance of hair becoming cellular, a vast number of Rainey's concretions which were easily distinguished from the spores. There is no reason to suppose that any fissiparous division occurred, which could scarcely account for the triple, quinquipartite, &c. arrangements. There was just one cell which seemed to indicate the probability of such an occurrence; it was oval, contained two nuclei, and resembled a torula cell; in all likelihood a spore in which endogenous formation was taking place, and not a preparatory stage of fissiparous division. The latter will certainly not account for the sudden increase in the quantity of fungus elements frequently observed; the separation is a slow process, and the supposed dividing halves are larger than those which form the mass of the fungus; the process going on was evidently a fusion of the cells, whose distinctness became more and more lost. It is reasonable, too, to expect that before such a process as subdivision occurred a certain de-

gree of development would be reached, but the *apparent division, in truth a junction,* can be noticed in the earliest condition of spore. It is curious that this fungus, which was obtained from a mucous surface, should take on the form characteristic of sarcina; *vide* Plate I. fig. 11. In tracing the steps in this change, so far as one can learn, the majority of the cells which had not conjoined are the result of endogenous growth and non-nucleated. Now and again a granular appearance is evident where the cells are of large size, but not a decided nucleus.

Tinea Versicolor.—Mr. Hutchinson brought before the notice of the Pathological Society, Dec. 17, 1861, evidence showing that the implantation of the fungus of tinea tonsurans may give rise to tinea versicolor in the adult. A child about two years old was brought to Mr. H. affected with tinea tonsurans (its three elder brothers and sisters being also subjects of the same disease). At one of the visits the nurse mentioned having some spots on her bosom, which on examination turned out to be patches of tinea versicolor. The child, it appears, had been in the constant practice of sleeping on the bosom of the nurse, and in consequence had communicated its fungus to the surface of the latter, and on account of the change of seat a modification of tinea tonsurans had resulted. Mr. H. remarked that the two affections differ in two respects—the age and seat at which they occur; and I gather that he was disposed to consider tinea versicolor as another aspect of tinea tonsurans, the differences noted in the contrast being accounted for by variations in the two particulars just named. It will be remembered that attention has been called to the similarity of tinea circinata of the forehead in a patient in a syncopal state and tinea versicolor, the former disease having been noticed to travel upwards to the scalp and actually assume the aspect of tinea tonsurans; a series of changes which clearly, in some measure, bear out the conclusive evidence brought forward by Mr. Hutchinson. The influence of seat comprises variation in the amount and character of hair, and the size of the follicles; moreover, the parts covered by

flannel (these being the selective seat of tinea versicolor) afford moisture (perspiration) in greater supply and regularity than elsewhere, and the fungus is increased largely where this is in especial abundance, viz., the epithelial tissues. "This proved contagion between two apparently different diseases" affords, to my mind, "support to the idea that all human fungi are one and the same," because it weakens very decidedly the heretofore great significance which attaches itself to dissimilarity in the external appearances of the various tineæ as differential indications.

Tinea versicolor, it further appears, may be produced by the implantation of the oïdium, as the following case, which occurred during my residence at the General Lying-in Hospital, apparently proves:—A young woman, aged 26, an inpatient, three or four days after her confinement, had febricula, to some slight degree, with intestinal disturbance, which was relieved by a warm purgative. On the 10th day of lying-in she was apparently perfectly well, but then complained casually of itching on the front part of the chest, sternum, and inner surface of the right arm. However, nothing was detected; the skin was moist, indeed, covered with free perspiration, and the irritation "evidently due to some local cause." In the afternoon little bright rings made their appearance, in size at first about that of pins'-heads; these gradually increased, the central part becoming of lighter hue than the external part. Fresh spots appeared in the form of erythematous circles during the next few days, the old ones increasing in size till they became as large as fourpenny-pieces, which then assumed all the characters of tinea versicolor. The changes in any one particular ring were very rapid (a few hours sufficing), the diameter keeping pretty constant, whilst the contained area enlarged. The redness often disappeared quickly, was influenced by pressure, and if absent, was brought back again by the application of external warmth; the patches felt harsh, and exhibited no true vesicles; those at midsternum coalesced and formed a patch of about two inches square. The disease appeared, in the first instance, close to the nipple, and travelled towards the mesial line,

where it subsequently took up its position. The spots on the forearm, close to the wrist, commenced a day or two after the first signs of the disease on the breast, and consisted of little red zones, which gave place to furfuraceous desquamation: in the course of a few days they died out. They might have been called slight tinea circinata, or tinea versicolor—either, I believe, would be correct; there were no distinct vesicles certainly to be seen. It is hardly to be disputed that the contact of the mother's arm against her breast explains the occurrence of the spots in the former situation. Now, it so happened that the majority of the infants in the hospital were suffering very badly from thrush, and the child of this woman in particular; no other parasitic disease was or had been in the institution, and taking all things into consideration, the seat and mode of onset of the disease, close to the nipple, travelling from the latter towards the mesial line, the negative evidence, &c., the conclusion that the tinea versicolor of the mother was caused by the implantation of the fungus of the child's thrush (oïdium) seemed inevitable and certain. It is right to add, that this case occurred some time before I had become strongly impressed with any such idea as that the parasitic fungi are identical. The disappearance of the disease from the arm of the mother was, in all probability, due to the existence of conditions unfavourable to growth, viz., ablution and absence of warmth and moisture, which were present at the breast. If I mistake not, Guersant, some years ago, hinted that "thrush" might be communicated from the child to the mother's breast.

There are some who look upon the arrangement of the spores of microsporon furfurans as characteristic of tinea versicolor. It is worthy of notice, that in the case of thrush, the spores of the oïdium are aggregated in little heaps. It is not any argument of moment, in regard to the identity of the two, because this feature is not peculiar to either of the two fungi just named.

Tinea Polonica.—I know absolutely nothing of this disease by experience, but the observations of those who have actually witnessed this form of tinea (especially those of Dr. Bidder),

make it the same essentially as the ordinary ringworm of this country. I cannot conceive upon what grounds some dermatologists reject it as of parasitic nature. No doubt, its physical aspect is in part to be accounted for by want of cleanliness, but the fungus has certainly been found committing its usual ravages; the matting together of the hair is the result of the pouring out of a peculiar gelatinous exudation, which infiltrates the hairs and renders them "sarcofied." Raciborski has noticed one fact which has some bearing upon the identity of the tineæ: he found large oval spores in one case, bearing the closest, indeed an identical appearance to achorion.

Summary.—Instances have been quoted to show—

A. Under the head of tinea favosa,

1. That the soil of tinea circinata is suited to the growth of achorion;
2. The similarity in some cases between favus and sycosis; and
3. Favus and tinea tonsurans (severe).
4. That favus may give rise to tinea circinata of the general surface in the same subject.
5. That favus during cure may assume the form of tinea tonsurans, and communicate tinea circinata. (Dr. Lowe).
6. The co-existence of favus and tinea tonsurans. (Hebra.)
7. The production of aspergillus by the germination of the achorion.
8. That favus may occur from the contact of a similar disease in mice and cats.
9. The probable occurrence of favus by the implantation of the torula. (Dr. Lowe).

B. Under the head of tinea tonsurans,

10. The co-existence, α, in the same subject, of tinea tonsurans and T. circinata—β, in different members of the same family, of tinea tonsurans, T. circinata, and sycosis.

11. The production of tinea circinata from tinea tonsurans, and *vice versâ* (Bazin, Hutchinson);
12. Of tinea sycosis from tinea tonsurans, and
13. The aspergillus by the germination of the trichophyton.

C. Under the head of tinea circinata,

14. The occurrence of T. circinata from contact with favus. (Dr. Lowe.)
15. The co-existence of tinea circinata, T. decalvans, and sycosis, and the production,
16. Of tinea tonsurans from T. circinata. (Hillier.)

D. Under the head of sycosis—

17. The relation of sycosis and favus.
18. The production of sycosis from T. circinata.
19. The co-existence of sycosis and T. circinata; and
20. T. tonsurans, tinea circinata, and sycosis in different members of the same family.
21. The implantation of the torula, giving rise to sycosis.
22. The analogy of disease in the pubic region and sycosis.

E. Under the head of tinea versicolor (chloasma),

23. Tinea versicolor produced by inoculation of the fungus of tinea tonsurans, or
24. From the oïdium.

CHAPTER XII.

Entophytes and their relations.

Having, as far as I am able, traced the clinical relations of *epiphytic* diseases and their fungi, it remains to examine the case of *entophytes*, or parasites found upon the mucous surfaces.

A good many writers seek to make a difference in the pathological tendencies of epiphytes and entophytes. As Remak puts it, "there is a remarkable difference between the pathogenetic relations of the achorion and the fungi growing in the cavity of the mouth, and probably also in aphthæ. The achorion takes deep root in the sound uninjured cutis, which, indeed, seems to be the only place where it attains its full development. The fungi of the mouth, throat, and air passages are, on the other hand, merely secondary products formed from the decomposition of the mucous membrane, the remnants of food, &c." I confess I do not comprehend the distinction here pointed out; in either case, the fungi require each its peculiar soil for growth, which latter takes place in consequence of the implantation of the germs upon a suitable habitat, and the properties and tendencies of these vegetations are the same in the two cases; but those conditions which enable them to take hold upon the surface, and those peculiar structures (hairs, &c.) which they attack with a marked predilection, are absent in the instances of fungi growing upon the mucous surfaces, for here there are no hairs and no follicles which enable the spores to find their way deeply into the textures. This

opinion is fully borne out by cases in which a fungus attacks part of the mucous surface furnished with hairs—*ex.*, the inside of the nostril, which occasionally becomes the seat of a disease assuming the characters of tinea sycosis, and here the hairs are attacked and damaged in a degree equal to that in cases situated at the contiguous cutaneous surface. There is one structure which is equally liable to be attacked by entophytes and epiphytes, and that is the epithelium.

The varying amount of the concomitant conditions of moisture, heat, and gaseous matter explains the contrast presented by the structural appearances of epiphytes and entophytes. These agencies especially conduce to the development of mycelium, and as they act more fully and constantly upon fungi growing upon mucous membranes, these (entophytes) are usually filamentous, while parasites of the external surface of the body are, as a rule, cellular or only partially myceliated.

Torula.—This has been found pretty extensively in the human subject; for example, in fevers, cancer, phthisis, hectic of all kinds, chronic vomiting. It forms, in conjunction with uredo, the cholera-fungus; Vogel has detected it in diabetic urine, Herapath and Quain in the urine of cholera patients, and Wedl in the loose stools of sucking children. I find in my note-book the following:—Miss H——, Feb. 2, 1859, subject of tinea tonsurans. Microscopic examination:—some of the knobs of the hairs are surrounded by a quantity of effused transparent blastema, the hairs are pretty well formed, surrounded by epithelium, amongst which are sporules and granular matter. The knobs are stumpy and surrounded by the same blastema, which, on the addition of liq. potassæ, is observed to be studded with sporules; they are split up in places, and no fenestrated membrane is seen. In one instance I observed rows (3 in number) of cells, which are oval, nucleated, and joined together by their extremities, arranged in a digitate manner, and shooting out laterally from the base of the hair. The whole forms an appearance exactly that of torula. Dr. Lowe has made very careful experiments upon the yeast plant. (*Vide Gardener's*

Chronicle, August 29, 1857.) Yeast consists of two kinds, surface yeast (oberhefe), and sediment yeast (unterhefe); the cells of the surface yeast are thick walled, and have in their interior a granular mass of blastema, from which nuclei result. The sediment yeast is a more developed condition of the surface yeast, and consists of thin walled cells filled with nuclei. The former kind is the most active. The latter burst and discharge their nuclear contents, which form the "globulins seminiferes" of Turpin, and from these result the thick walled cells of the surface yeast. This, according to Dr. Lowe's observations, is not usual in normal fermentation, but occurs only in old acid yeast. In true fermentation a budding of the thick walled cells takes place, and this ceases with the fermentative act. The cells then become oval, mycelium is formed, and the fructification of aspergillus glaucus results. Mr. Berkeley believes in the latter fact, and from Dr. Lowe's further experiments it seems quite clear that the aerial spores of penicillium are converted into torula, a statement that I can confirm from my own repeated observation.

During the development of the achorion the cells become oval, nucleated, joined together, and put forth sprouts, and a similarity is by no means rare between it and torula; indeed, some authorities have looked upon the two as identical. The resemblance, again, of the trichophyton sporuloides (tinea polonica) to torula is portrayed in the description of Von Walther, who says the spore may be oval, with a dot or spot in its body, and may contain two little vesicles; may have more; if there be three they lie in a longitudinal direction, one at each pole; if they differ from torula, it is in the fact that they have not been observed to sprout, and are smaller. Plate IV. fig. 4, represents a modification of aspergillus resulting from the growth of the torula.

I shall refer more fully to this under the head of Aspergillus, suffice it now to say, that in this evolution several stages are passed through before the full result, which present appearances said to be characteristic of distinct species.

Ex., some of the mycelial threads are those typical of oïdium, and others fully bear out the statement of Küchenmeister, that the surface yeast of Mitscherlich and Lowe is a leptomitus. *Vide* Plate III. fig. 2 A. I ought to state that I have not drawn any conclusion from a limited number of observations, but have traced out the development step by step, from the simple torula cell to the most perfect form of mycelium. I do not think it necessary to enter into detail here, further than to state, that these modifications of mycelium which tend to show that the oïdium, leptomitus, and torula are mere varieties of one common fungus, have occurred together springing from the same mycelial thread, as in Plate III. fig. 1 A B. A few years ago some very spirited discussions took place as to the nature of the so-called cholera bodies, and figures were given in various journals representing a new species of fungus. It is now pretty generally admitted that uredo and torula, with their modifications, make up the list of cholera fungi. Dr. Hassall (*Med.-Chir. Transactions*, vol. xxxvi.) has attempted to show that a species of fungus allied to torula, and distinct from penicillium, occurs in saccharine urine: however, at the present day, the several variations of form which he figures are looked upon as modifications of one fungus.

Sarcina.—Very little is really known about the mode of production and source of this fungus, but I hope to help towards the solution of some of the mysteries which surround its history.

It has been found in very many different parts of the body, and variable pathological states, chiefly however in connexion with chronic disease of the stomach. It has been detected also in the following instances:—

A. Fluid of the ventricles of the brain, by Dr. Jenner.[1]

B. In urine, by Heller,[2] Mackay,[3] Bence Jones,[4] Welcher,[5] and also by Beale, Johnston, Begbie.[6]

[1] British and Foreign Med.-Chir. Rev., Oct. 1853. pp. 530-2.

[2] Eine Eigenthumliches Harn sediment. Archiv für physiol. und patholog. Chem. und Mikroscopie. Heft 4.

[3] Bennett's "Lectures on Clinical Medicine." July, 1851.

[4] Microscopical Journal, vol. i.

[5] Microscopical Journal, vol. viii. p. 163. [6] Edin. Med. Journal, ap., 1857.

c. Lungs,[7] by Virchow,[8] Zeucher.[9]
d. In fæces and intestinal canal, Bennett and Hasse.
e. Gangrenous intestine (Demme).
f. Cholera stools (Wedl,[10] Mensonides).
g. Bones (Mr. H. O. Stephens).[11]
h. Stagnant water (Dr. Lowe).[12]
i. Fluid of hydrocele (Dr. Lowe).[13]
k. Tinea tonsurans (the Author).
l. Stomach of rabbit (Virchow); ditto of dog (Frerichs); ditto of ape (Eberth); and cæcum of fowl (Eberth); also in the tortoise.

"Dr. Hermann Itzigsohn directs attention to the fact that sarcina, in common with all phycochromatous so-called unicellular algæ, is neither a true species nor genus, but only a stage in the development of some polycellular filamentous algæ, probably an oscillatoria; that the sarcinæ are, in fact, the free ripe gonidia or spores of some such alga. Their independent growth is no barrier to this view, as they have that in common with many other spores, as those of various lichens, which often form large pulverulent masses on stones, wood, &c., and also with those of many other algæ. He adds, also, that these gonidia are so minute as to be easily taken up by the absorbents, and carried by the blood-vessels to the bladder, bronchi, &c.; in a dry state they may be even inhaled with the air, and subsequently grow."—*Edin. Med. Journal*, Jan. 1859, from *Allg. Wien. Ztug.*

It is necessary to examine the case of sarcina in reference to

1. Its nature.
2. Pathological relations.
3. Source.
4. Varieties.

1. Its vegetable nature is scarcely now-a-days called in question; should, however, proof be required, the details

[7] Microscopical Journal, vol. ii.
[8] Schlossberger, Die Sarcin. Wurtemburg. Corresp. Bl. N. 26.
[9] Henle's Zeitschrift. Band iii. p. 117.
[10] Microscop. Journal, vol. viii. p. 163.
[11] Do. do. do.
[12] Gardener's Chronicle, 1857.
[13] Edin. Med. Phil. Mag. N. S. July, 1860.

presently to be presented under the head of Source will be sufficient to establish the more generally accepted view. The characters usually relied upon as exhibiting its vegetable nature are its behaviour with iodine and acetic acid, its similarity to algæ, and its quaternate form. The presence of chlorophyll is decidedly not distinctive of algæ, for it is present in the germination of many fungi.

2. Our knowledge of the attendant circumstances necessary to the development of sarcina in the human body is very deficient; it appears, however, that the combination of the following four conditions, if not actually necessary, at any rate greatly favour its production.

A. The detention for awhile of the secretions or fluid contents of the organ in which sarcina occurs.

B. Access of external air.

C. The presence of acidity. (This may be a result of the development of sarcina.)

D. A certain degree of warmth.

The growth of the fungus is not necessarily connected (clinically speaking) with any serious results, as cause and effect; it is not necessarily attended by notable symptoms; and it is secondary to, and not a cause of disease, excepting in so far as by accelerating putrefactive and fermentative changes, it adds to the local irritation and discomfort. The latter disappears when the fungus is destroyed, but the primary disease remains unaffected; practically, the presence of the parasite implies obstructive disease. The vinous, acetic, and butyric fermentations accompany it.

There are certain co-existences of tolerable frequency, viz., the presence of torula and penicillium. Simon (of Halle) argues therefrom that sarcina is a modification of torula.

A word or two more in regard to one of the circumstances which seem to be favourable to the growth of sarcina, viz., the access of the external air. We can readily establish the existence of a communication between the exterior and the spot whereat the sarcina is produced in all instances but one, viz., the urinary organs, where it is supposed the

fungus may take origin, as has been suggested by Dr. Lowe (*loc. cit.*), from nuclei which find entrance into the system by the circulating current through slight lesions of the capillary system, in like manner as supposed by Dr. Laycock in the case of diphtheria. This hypothesis is considerably weakened when we take into account,

1. The general mode of formation of sarcina.

2. The result of experiment, viz., the injection into the blood of parasitic elements.

3. The absence of anything analogous to the "boring" properties of parasitic worms.

4. The limitation of their formation (when introduced into the blood current) to the kidney. Seeing that the germs of fungi are abundantly introduced into the body from without, and that sarcinæ are not uncommon in the body, if the germs get into the blood it is improbable that their formation should be limited to the urinary apparatus alone; and further, seeing that the sarcinæ are found external to the proper structure of the latter, that is, in the excretory channels, the germs must get out again from the blood current. The only case which countenances such a view is that recorded by Dr. Jenner, in the *Brit. and For. Med-Chir. Rev.* for October, 1853, p. 531, in which sarcina was detected in the fluid of the ventricles of the brain, but the fluid was not examined until forty-eight hours after its removal from the body. "Supposing (says Dr. Jenner) the sarcinæ to have been developed in the fluid *after* its removal from the body, then this case stands alone, inasmuch as they have never before been known to form, except in the interior of the bodies of animals." This statement is at the present time untenable (when first written by Dr. Jenner, however, it was perfectly true). Dr. Lowe has found the entophyte in the fluid of hydrocele and stagnant water; Mr. Stephens, on bones; and, as will presently appear, I have seen them develope out of the body.

When sarcina is met with in the urine, in the majority of instances it is developed after the escape of the latter from the body, and its source in some of these cases is

really the stomach, a mixture of vomit and urine having taken place. More careful observation upon the matter is needed. Has the fungus been found imbedded in the substance of the urinary organs, or only in their excretory channels? Has the urine been examined at once on opening the body, or has it been allowed to remain exposed for awhile to the air? Could such a procedure as catheterism explain the presence of sarcina by admitting air, and consequently the germs of fungi? So far as I know, there are no observations which decidedly prove that the germs of the sarcinæ found in the urinary secretions could not have been derived *ab externo*, but must have come from within the body (the blood).

Source and mode of formation.—Several theories of the formation of sarcina have been propounded, but the belief in fissiparous division is almost universal. Simon, however, holds the occurrence of endogenous formation as necessary. A very good description of the supposed formation by fissiparous division is to be found in the *Med. Times and Gazette*, vol. ii. 1853, pp. 523-24, by Dr. Ransom.

My own observations, made with great care, differ very materially from any account yet given of sarcina. In the paper of Dr. Lowe before referred to, a suggestion is thrown out that the germs of sarcina found in the body may possibly be the "globulins seminiferes" of Turpin, or the nuclei of yeast cells. A somewhat similar impression has been gaining credit among botanists. Mr. Berkeley, in the *Gardener's Chronicle*, August, 1857, expressed the belief that sarcina is only a modification of some one of the ordinary forms of mould, and states that he has been unable to substantiate the connexion by experiment. My attention was particularly called to the subject in 1857, in consequence (when conducting some experiments with the fungus of ringworm) of finding the quaternate arrangement of spores, the counterpart of sarcina, in a case of tinea tonsurans. I failed, however, invariably to produce the like condition artificially, under a great variety of circumstances, until March, 1860. A month before this period I had "put up" from the

nostril in liq. potassæ, a hair infiltrated by the microsporon, or what is the same thing, the trichophyton, and as has been already described, a quaternate form of fungus closely resembling sarcina resulted. This led me to question the accepted doctrine of the formation of sarcina by fissiparous division; but I could get at very little additional experimental evidence till the following July. In that month a case presented itself to me which offered the very conditions I desired. The symptoms consisted of violent diarrhœa, accompanied with vomiting of sour fluid, there was no organic disease present, and in the vomit nothing could be detected, after most repeated and careful examination, in the shape of fungi, but spores of penicillium. The attack itself appeared to be the result of severe mental anxiety. Some suspicion of poisoning had crossed my mind, and on that account the greatest care was taken to receive the vomit into a perfectly clean vessel, and to keep it securely from the influence of external agencies. I placed the fluid near some hot-water pipes which always contained water at an average temperature; by this plan I hoped to keep the fluid at a temperature about that of the stomach. The changes which occurred in the fluid I watched for the space of a year. It soon became evident that torula cells were produced by the growth of those of the penicillium, which enlarged, joined together, became oval and nucleated. Now, it might be supposed that the bodies which appeared to me to be spores of penicillium were in reality gonidia. This, however, is entirely disproved by the actual changes which were observed to take place, it being admitted by recent observers that torula is an advanced condition of the aerial spores of penicillium; moreover, there was nothing present from which gonidia could result, and no transitional stages (from the round to the quaternate cell) intimating a fissiparous division.

The next step was the formation of a mycelium, which resulted in the production of a fructification bearing the characters of aspergillus in some instances, and at others of penicillium. Some of the torula cells enlarged, with endo-

genous formation of nuclei, and bursting, discharged their contents, which appeared to go through exactly the same changes as the parent cells. Plate II. fig. 13.

Many of the spores of the penicillium, instead of going through the changes above described, that is, arranging themselves in a linear manner, and forming mycelial threads, clustered together in little packets, varying from two to twenty cells; this condition was a distinct union, which could be traced from its earliest stage, and could not be disturbed by manipulation. The cell walls at the point of junction in many cases became indistinct, absorbed as it were the one into the other, but the cells never lost entirely the aspect which suggested their original distinctness.

It is highly important to add that the individuality of the component cells became more and more indistinct as the changes advanced. The quaternate form was by no means uncommon, and though at first not so perfectly that of sarcina, in the fact that the angles were more rounded off than usual, yet its resemblance was decided, and the similarity gradually merged into identity as the development advanced. The exceptional condition (the rounding off of the angles) was noted by Dr. Jenner in the case of sarcina in the fluid of the ventricles of the brain of which mention has been made.

In addition, there were little columns of the quaternate series of cells, analogous to those found in connexion with sarcina in the stomach. The older these packets were, the more like perfect sarcinæ did they become. The contents of these bodies became granular, and darker than the original component cells, and in some, nuclei were visible. The early changes may be seen in Plate II. figs. 8, 10, 11. In the meanwhile many of the torula cells had enlarged, become full of nuclei, and here and there had ruptured, and the discharged cells assumed the conjoined quaternate form, as in the case of the original spores, and thus was produced minute sarcinæ (fig. 13). It is perhaps as well to state that no effect was produced by the addition of dilute acids.

I could make out very little as to the further progress of

the quaternate spores, and I apprehend it will be long ere their destination is determined. So far as can be learnt, endogenous formation of nuclei occurs as the result of the junction of cells and the mixture or mutual influence of endochromes; the contents are then discharged, and undergo the same series of changes as the original cells; or, being acted upon by different concomitants, assume other allied forms. I infer this from the changes that have taken place in a preparation of sarcinæ, which was "put up" some years since, and in which I found several thick-walled, broad cells, and sarcinæ losing their distinctness as such, becoming larger, and finally giving place to an aggregation of minute cellular granules. In watching any preparation, the influence of the external air is withdrawn, and the growth of any fungus is thus brought to a stand-still. Latterly, however, I have contrived to introduce a few air-bubbles into any preparation that I have desired to develope, with very good result; for the fungus, whatever it has been, has generally gone on growing as long as it could get supplied by the air present. Under these circumstances I have seen the aerial spores of penicillium assume, amongst others, the quaternate form, due not to a mere approximation but to a positive union of the component cells, and which bore all the characters of sarcina to a very high degree. In all these artificial cultivations it is impossible to imitate correctly those coincident conditions which are associated with the growth of fungi in their several special locations, and therefore nothing more than an *approximation* is really to be expected. When, however, our knowledge of the habits of fungi is more certain, no doubt experiment will have its triumph.

There is an apparently different mode of the formation of sarcina, which seems to offer to the partisan of fissiparous division good warrant for his opinion. The mode just described is a conjunction of cells; fissiparous division is a cleavage of a parent cell. That I now refer to occurs thus: The nuclei seem to enlarge, and to occupy the whole area of the original cell, which does not give exit to its contents as soon as usual. In this way the cell becomes occupied

by four enlarged nuclei, which become conjoined; the original cell-wall disappears sooner or later (*vide* Plate II. fig. 16). Now, in this case the process is exactly the same in nature as in that before described, only the component cells have not escaped from the parent cell before they join together. Herein is no support given to the existence of fissiparous division; the old cell is not divided, but its area is taken up by the cells in its interior. I am not aware if this is exactly Simon's view. It tallies entirely with the representations of sarcina given in many works, in which some of the accompanying forms are large oval, or even square cells, containing what appears to be a tripartite mass, or as others would say, made of three masses—a condition which is utterly inexplicable by the occurrence of fissiparous division. Such bodies as these, when oval, and containing two large cells, may, when examined by a high power, exhibit very much the appearance of a duplicate subdivision, which, however, is due to the peculiar action of the light upon the contents; and these are they which the expectancy of observers who place implicit reliance in the doctrine of fissiparous growth has described as an early stage of the production of sarcina by the division of the parent cell—indeed as a gemmation. In the fluid in which sarcinæ were forming, and from which I have drawn my inferences, the mode of formation was by junction of free cells, only in rare instances by the amalgamation of intercellular bodies.

I am compelled, then, to disbelieve in the formation of sarcinæ by fissiparous division, and hold that they result from a junction of the free cellules derived from the aerial fructification of one of the ordinary forms of mould, viz., penicillium; and further than this, it appears that the nuclei discharged from the fully developed cellule of penicillium (which is torula) may also assume the quaternate arrangement, and give rise to the existence of minute sarcinæ. This is the source suggested by Dr. Lowe, who, however, believes that fissiparous division is the manner of their development from the nuclei of torula. In addition to the evidence of direct

observation, certain minor circumstances militate against the doctrine of fissiparous growth.

1. The size of the component parts of sarcina is the same as the elementary cells, and this would appear to lend support to the observations I have brought forward, and indicates a junction.

2. There are no intermediate stages of growth (such as must necessarily be present in fissiparous growth) between sarcina and the simple sporular form.

3. There are, however, perfect links marking out the relation of spores and sarcinæ, as produced by a junction.

4. The supposed division is more distinct at the early age of the quaternate spore, which implies—

5. That the progress of the development of the latter is certainly not towards complete division; in other words, the free spores cannot be traced to produce the quaternate form by a process of cleavage.

6. The quaternate form appears at an early stage of germination, and coincident with an early age of cell; whereas fissiparous division should rather take place at an advanced condition of spore.

7. The large sarcinæ appear before the production of the small ones, viz., before the nucleated cells have been produced, and their contents discharged by rupture.

8. The absence at the outset of any large cells that could by fissiparous division give rise to sarcinæ.

Varieties.—In the *Microscopical Journal*, vol. viii. p. 163, is an account of sarcina found in the urine by Dr. Welcher. The following existed together:—

(*a.*) Isolated cells, ·001 to ·0018, rounded, angular, no nucleus; iodine rendered them yellowish brown.

(*b.*) Cubical masses, showing on each face 4 cells, composed there of 8 cells, size ·002 to ·0027.

(*c.*) Cubes with 4 cells each side, made up therefore of 16 cells, size ·0042 to ·0052.

(*d.*) Columnar sarcina masses, from ·005 to ·0025, composed of 64 cells.

Dr. Welcher gives the following measurements:—

	Urine.	Stomach.
Size of primite cells.	·0012	·0025m.
Cube of 8 . .	·0023	·005m.
,, 64 . .	·0048	·010mm.
,, 512 . .	None.	·02m.
,, 4096 . .	None.	·04m.

The inference drawn is, that the size of sarcinæ found in the stomach is about double that of those found in the urine; and also that no cube of 512 cells and upwards is found in the urine. Upon these two data Welcher argues that there are, at any rate, two distinct species of sarcina; but in the observations which I have detailed, the small and large sarcinæ were shown to be one and the same in nature. The difference is one of degree merely, the circumstances are so much more favourable for the free development of sarcina in the stomach than the urine.

Relations of Sarcina.—If the preceding details are correct interpretations of facts, there are at least three fungi which may give rise to, and which are identical in nature with, sarcina, and they are penicillium, torula, and trichophyton. Penicillium is the source from which sarcinæ are most commonly produced; torula is only another form of penicillium (an interchangeable condition); trichophyton, too, according to my observations, may assume the quaternate arrangement.

I wish more particularly to call attention to the relation of puccinia and the source of sarcina. In the germination which forms the subject matter of these remarks, as will be seen by reference to the drawings, Plate II. fig. 12, in the mycelium the appearance of puccinia was produced by the formation of a capitate fructiferous stalk, either by budding or by the enlargement of original cells, which in part make up the mycelium. This was the statement which I advanced in the *Lancet* in 1859; and, without going into detail, the drawing suffices to confirm it, and shows much more satisfactorily than any words can do, the point which I wish to indicate.

In the instance of the disease known in India as the "Madura foot," Dr. Vandyke Carter found, on microscopical examination of the fungus, quaternate spores, and this fact

has its bearing upon the question at issue, as showing the great probability that sarcina is allied to the ordinary forms of parasites.

In the *Gardener's Chronicle*, August 29, 1857, p. 596, Mr. Berkeley writes, "A very curious production has been lately sent to us by Mr. H. O. Stephens, which he found in the shape of an orange gelatinous stratum on bones which had just been landed from a South American vessel on the quay at Bristol. Mr. J. Lowe has lately shown in a memoir read before the Botanical-Society of Edinburgh, that some of the moulds which occur on living animal structures, and which constitute numerous new genera of authors little versed in fungi, though skilled anatomists and pathologists, are merely forms of aspergillus glaucus. Of this we have long been convinced, including, however, penicillium glaucum, and we have endeavoured in vain to prove the case by actual experiment in the instance of sarcina, which occurs in malignant disease of the stomach, and is remarkable for its quaternate spores. Hitherto, however, no such spores have occurred in the coloured gelatinous masses so common on decayed food, and which undoubtedly are the infant state of our common moulds of the genera aspergillus and penicillium. The orange matter of Mr. Stephens now supplies the desideratum, and we have spores in fours, either in detached packets, or forming a continuous stratum consisting of several sets of four, exactly as in sarcina."

The observations that I have detailed are, then, as regards the source of sarcina, quite warranted by and in keeping with the expressed opinion of Mr. Berkeley, who may be looked upon as the highest authority in reference to this matter; at the same time I am compelled to reject the theory of fissiparous growth, and to accept that of conjunction as explaining the production of sarcina.

Oïdium albicans.—Küchenmeister has given a most elaborate account of this fungus.

It is highly probable that the forms described under the head of Leptomitus, the vaginal parasite, the fungus which Hannover found in the œsophagus, Bennett's fungus, that

found by Rayer and Gairdner on the pleura, and in tuberculous cavities by Remak, are nothing more than stages of the oïdium. Berg, Grüby, Eichstedt, Müller, Retzius, Lebert, Robin and Vögel, notice the similarity of achorion and oïdium. Berg regards leptomitus Hannoveri and Bennett's fungus as oïdium. Küchenmeister thinks the nail fungus is an oïdium, but according to Meissner it is an achorion. There must be some very close relation between the oïdium and other fungi to lead such high authorities to adopt such opinions as those contained in the above statements. I have made a great number of experiments upon the point, and have traced the production of the oïdium from the torula; the latter sometimes takes on the form of penicillium, at other times, near the base of the mycelial threads, that of leptomitus, and occasionally terminates in filaments which are usually regarded as characteristic of oïdium. Words ill supply the place of actual illustrations; I therefore refer the reader to Plate III. fig. 1 *a*, and 1 *b*, which represents the leptomitus and oïdial thread upon the same stem, produced from the growth of the torula in saccharine solutions, which I observed in July, 1859. Dr. Bidie has called attention to the similarity of the chionyphe Carteri and the tribe oïdium.

The group Mucor, Aspergillus, and Penicillium.—The distinctive characters of these fungi are to be found in their fructifications. The mucor is said to be known by its capitate head, full of spores, bursting when placed in water, and discharging its spores; the aspergillus by its terminal radiate fructiferous stalk, to which are attached the spores, or by the spores being collected around and seated upon what is termed a receptacle or placenta, as it were; and penicillium by the tuft of spores arranged in a finger-like manner. When we seek for evidences of these diagnostic points in actual specimens of this or that fungus, we shall find them at one time pretty well marked, and at others indistinct, and it is by no means uncommon to find some of the supposed diagnostic characters of one appropriated by the other. For example, in germinating

favus, you not unfrequently meet with mycelial threads terminating in a capitate head containing a few sporules. Plate II. fig. 7.

Plate II. fig. 2 is a representation of the fungus of tinea circinata in its mycelial form, one of the threads of which terminates in a clavate head; in oïdium we see the same phase of fructification. Aspergillus is sometimes seen without the receptacle, and there may co-exist the receptacle and the radiate arrangement of tufts; for my own part, I could never clearly make out the absolute differences described in books.

In tracing the development of the torula, the achorion, and the aspergillus, the exact relation of the sacculi (or dilatations in the general course of the mycelium), the clavate heads, and the full fructification is well seen, and it is easy to recognise a great uniformity in *the plan* of growth. Speaking generally of the fungi under consideration, this is what appears to take place. As the first step, a junction of sporules takes place, and the mycelium results therefrom. Now, with regard to the nature of this junction, I believe it is a true and indisputable union, accompanied sooner or later by the admixture of cell-contents, and from this there result, in the first place growth, which takes place more especially by elongation (thus the mycelial threads are produced); in the second place, the two processes of budding and endogenous formation of cells, which do not need further description. The next step consists in the production of dilatations, which may be terminal, or in the course of the mycelial threads, in which case some part of the actual filament may become sacculated, or a globular enlargement may be formed laterally as regards the tubes. The sacculi, or non-terminal dilatations would seem to become filled with cells, which escape by the rupture of the parent cell, the shrivelled and torn sac being often visible. The terminal clavate bodies also become filled by endogenous formation with cells, and the mucor stage is reached; if the contents be well developed at an early period, the sac wall ruptures with discharge of the contained cells, especially

if the fungus be placed in water, by which fluid is admitted into the interior by an endosmotic action. The terminal cell may be given off from the parent stem, and this may occur repeatedly, as in the oïdium tribe (by a process of budding), but this happens rather in those instances in which the cells at the extremities are not particularly well developed, when they are of tolerably small size. The next stage consists in the disappearance of the cell wall, and arrangement of the cells in a clustering manner around a receptacle, which is produced by an irregular process of budding, or an enlargement of the terminal joint of the mycelial tube (receptacular filament), in which case aspergillus results, or the approximation or junction of the individual cells in a radiate manner, in which case penicillium is attained. From the accounts and descriptions given by some, it would appear that the aerial "spores" are produced by a process of budding; this is difficult to recognise, and it is evident to me that the aspergillus and penicillium, in reaching their perfect forms, pass through a stage which is apparently identical with mucor. If reference be made to vol. v. of the *Microscopical Journal*, there will be found the representation of a fungus found in the ear, and described by Mr. Grove as having the characters of aspergillus; and if attention is directed to fig. 5, a condition very decidedly that of penicillium will be noticed. Consequently, the two apparently different fungi grow upon the same plant. This latter coincidence is not rare. It is very interesting to remember in this place (as showing the very close relationship which subsists between the members of the group under notice) that the ear fungus is an aspergillus according to Robin, and a mucor according to Sluyter, and oïdium according to Pacini.

In the *Lancet* for Nov. 19, 1859, Dr. Hassall has described and figured what appears to be a distinct fungus found in the urine. It consists of sporules, which are oval and rather larger than those of penicillium; of threads which are "very slender, but little branched," and of free fertile threads, which are compound, *i.e.* made up of several filaments,

bearing at their summits masses of oval cells (sporophores). The distinctive characters of the fungus are the compound nature of the vertical stems, and the form (oval), size (large), and arrangement (clustering) of the spores in the fructification; and the conditions favourable to its development are *an alkaline state of urine*, the presence of animal matter, and exposure to air. I have repeatedly seen this fungus, and have usually looked upon it as a modification of aspergillus, for the simple reason that the fructification of aspergillus is found in conjunction with it, and the study of its development would seem to show that in reaching its perfect condition it passes through a stage represented by mucor, viz., terminal sporangia full of sporules. I have seen it develope in urine to which favus matter had been added, while at the same time it could not be detected in any form in a portion of the same urine to which no favus had been added. I am bound to say, however, that the vertical stem has in the majority of cases been simple, rarely it seems to be compound; but this is due rather to the collection together of two or more fertile threads than their approximation and definite union, at least such as would constitute *one* stem, and indeed the appearance of the base of the latter, where it springs from the general mass of the thallus, is sufficient to show this; for the component filaments of the compound stem rise up some distance apart from each other, and only join after reaching a certain height. The fungus might be very properly considered to be a mucor in which some of the sporules were free, and it is only necessary to imagine the sporules arranged in a radiate manner to produce penicillium, or to cluster around the enlarged terminal point of the sporophore, so as to give rise to a resemblance of aspergillus. The oval character of the sporules and their size, of course avails little. Are not the concomitant circumstances sufficient to explain the peculiar aspect of the fungus in question? Here, as elsewhere, the well observed facts and opinions of others have been mentioned, inasmuch as they come from sources which have no expressed bias towards the view of the identity of fungi, and are not open to the charge

of exaggeration which might be brought forward against those adduced as the result of my own observation; and the latter carry greater weight when they harmonize the apparently discordant statements of authorities.

There are three sets of cells whose nature and offices demand notice—viz., those in the general tract of the mycelium; those in the sacculi and clavate heads (sporangia), and the aerial bodies. The cells found in the first category are large and small. Dr. J. Lowe regards them as analogous to the antheridia and pistilidia of ferns; they are probably different stages of the same kind of cell. The second division of cells, viz., those formed in the sacculi and sporangia, and those of the remaining class, the aerial spores, are all originally formed within dilatations of the mycelium, and offer no distinction in their nature. Now, the latter are the *direct* consequence of the junction of cells (formation of mycelium), and possess two properties—that of endogenous growth, and that of budding—which are probably distinctive, for they are not exhibited, so it seems, by their contained cells; in other words, cells the *immediate* result of the formation of mycelium are distinguished by two features, budding and endogenous growth; other cells must join together before either of these properties is obtained. It may be that this is an erroneous view, but such is the inference that I have drawn from a careful examination of the development of the aspergillus: it is unnecessary to add how great is the difficulty in estimating correctly the several series of changes. There should be, then, a distinction made between the cells the immediate consequence of conjunction of cells or the formation of mycelium, or spores; and secondary cells, or sporules. This leads us to inquire into the nature of the formation of the mycelium. At first sight it appears a very legitimate inference to conclude that it is a true generative act, that the reproduction of the plant has absorbed all other functions; certain it is, that it is followed by mixture of endochromes or cell contents, the production of a large quantity of cells by endogenous growth, and the occurrence of budding. I think, however, from what I have seen, that the true, or rather the most perfect degree of genesis,

conjugation, or reproductive act, takes place in the growth of the aerial spores. (There may be some difference of sexuality in the cells or spores formed in the various parts of the mycelium; at present we are without warrant for such an assumption.) Let us take the familiar torula for illustration: the sporular (nuclear) form, which is the indirect or secondary result of conjunction, that is, formed by endogenous growth within cells the immediate result of conjunction, or in other words the aerial cells, or ordinary spores of penicillium; these perpetuate themselves without change, an alteration in aspect occurs after they join, and give rise to mycelium. The aerial spores of penicillium, on the other hand, enlarge, become nucleated, and bud, in consequence of their potential characters. It is acknowledged that what is called the fructification of the aspergillus and penicillium is the most developed state of fungus; consequently, it is somewhat contradictory to seek for the generative act elsewhere than in a prior stage. The endogenous formation of cells and budding, moreover, are things which by analogy are consecutive to the performance of the function of reproduction, and serve to direct us towards the formation of the mycelium as the time and place of the sexual act. In the instance of budding, the derivative assumes the characters and properties of the parent cell. The power to conjugate depends very much upon the degree of development of the cell and the influence of external conditions; in its early state, and when the influence of the air is removed, it rarely does so.

In the *Gardener's Chronicle* for August 29, 1857, are the details, at p. 599, of some experiments of Dr. Lowe upon the development of the yeast plant. In examining the results of his experiment, Dr. Lowe felt convinced that several species and genera of aspergillus (the developed torula) were present. "In proof of this, a series of experiments were made in Messrs. Jeffery's brewery, with the following results:— 1st. A quantity of mixed penicillia and aspergilli (P. glaucum, Asp. glaucus, Asp. nigrescens, &c.) were placed in a gallon of wort at a temperature of 65° F., and allowed to stand in the tun-room. On the second day the surface was covered with

specks of foam. On the third day the fermentation had fairly set in, the surface became coated with pale yeast, showing under the microscope, oval non-nucleated cells in a state of germination. On the fourth day the fluid gave off a nauseous 'foxy' odour, which disappeared on the sixth day, when the yeast cells were observed to have become spherical, and in all respects like good yeast. On the eighth day the yeast was removed from the surface and applied to a fresh quantity of wort at the same temperature. This entered into fermentation on the first day, and exhibited all the characters of perfect yeast."

The second experiment was made by placing a portion of penicillium glaucum in wort, under the same circumstances as in experiment 1. The same series of phenomena ensued, ending in the production of good yeast. A third and fourth experiment were made with aspergillus glaucus and A. nigrescens, with like results; the only difference being that the sporules produced by the latter were at the commencement larger and more spherical than in either of the other species, from which it may be inferred that this species would yield a better kind of yeast. Dr. Lowe very rightly adds, "the idea that yeast can be produced spontaneously in nitrogenized fluids we hold to be entirely erroneous, for we see that the lower class of fungi are capable of yielding it, and from the general distribution of these they must be present in every kind of exposed fluid." Concluding that care was taken to ascertain that the germs of the torula were derived from no other source than that supposed, these experiments mean, *in nature* · aspergillus, penicillium, and torula are the same, and different stages only of one common form. Such is the belief of Mr. Berkeley, mentioned under the head of sarcina.

I suggested, a moment since, the probability that some special evidence of the reproductive act may be found during the development of the aerial spores; these may by junction and budding form mycelium, which generally assumes a darkish hue. On one occasion I noticed that some of the filaments gave off free cells, and at two points little flask-

shaped dilatations were seen, and these apparently gave exit to a number of little elongated cellules resembling spermatia. I did not observe any mutual action between these two classes, but suspect that this state is the clue to the discovery of the true reproductive act. Plate II. figs. 5 and 6, is a rough sketch of the appearance in question.

The study of the development of this group appears to indicate that mucor, aspergillus, and penicillium are different evolutions of one and the same fungus; that the aerial spores and those within the sacculi are likewise identical, and produced by endogenous growth; moreover, that torula is the advanced stage of the spore of penicillium.

The connexion between achorion and aspergillus on the one hand, and penicillium and sarcina on the other, has been noticed.

The best illustration of the foregoing remarks, which exhibits not only the developmental stages, but also the extreme variability of fungi, may be perhaps obtained in the figures of Dr. Hassall (*Med.-Chir. Trans.*, vol. xxxvi.). The simplest state, that of the round spores of *penicillium*, soon merges by growth into that of *torula*, for the cells enlarge, join, become oval, nucleated, and bud, mycelial threads are soon produced and the fructification of penicillium results. Now, it is easily apprehended, as is the fact, that the appearance of any terminal filament is greatly modified in each particular instance by the changes which ensue in the component cells; the globular dilatations or sporangia may remain or give place to the perfect form of fructification. In the latter case the cells or spores may be aggregated together around one filament, or, by budding or the junction and elongation of these cells, fungi-like processes arise, and at the ends of these the remaining cells are attached, and in the figures in question there are different degrees of this condition. Again, pieces of mycelium may enlarge greatly, with the production of globular dilatations or sacculi unequally, so that leptomitus is portrayed, or the threads may be slender and the terminal sporangia full of cells, in which

case the form of fungus becomes that of mucor, as Dr. Hassall's last figure shows.

It will be remembered that in detailing the characters of chionyphe Carteri, Mr. Berkeley was reported to have observed that the artificial germination of the cells derived from the filaments gives rise to "a perfect mould;" that the fungus closely resembles the genus mucor (but there is no columella in the sporangium); and that the chionyphe *may* take origin from the mucors.

Many years ago Kützing wrote thus:—"Yeast is an alga in its lowest, and a fungus in its higher grade of development," and, "there results from elongation and intimate adhesion of the cells an articulated filament whose segments have a cylindrical form. The filaments extend themselves either into very delicate fibrillæ or they expand themselves into larger elongated cells, which finally swell up to the form of vesicular spheres, in which great numbers of little globules (sporidia) are formed; *in this stage, therefore, they completely resemble a mucor.*"

The Leptomitus Group: L. Hannoveri, L. uteri, L. oculi, L. typhus, Bennett's fungus, and that found on the pleura. —Many observers have marked the close relation which these bear generally to the oïdium. Küchenmeister has observed that the mycoderma of the yeast, the surface yeast of Mitscherlich and Dr. Lowe, is leptomitus. Under the head of torula reference has been made to this, and Plate III. figs. 1 *a* and 1 *b* represents the fungus as produced from the torula in conjunction with the fructification of the oïdium. Fig. 2 *a* is another example of the production of the fungus under consideration from the torula. It is only right to add that the various steps of the development were carefully watched. Some years since Dr. J. Stuart Wilkinson gave the name of Lorum uteri to a fungus which he discovered in the fluid collected from a case of uterine disease. His observations were recorded in the *Lancet*, p. 448 *et seq.* 1849; the name Lorum, signifying a thong or lash, was given to it because it consisted of primitive fibres giving off secondary filaments. Many of the filaments ended in flask-

shaped cells, or the latter formed part of the general tract of the mycelium; in addition were found oval nucleated cells, with smaller ones budding from them. These appear to be nothing but torula, and the lorum itself a modification of leptomitus; such a condition is by no means rarely seen in watching the torulæ in the progress of its development into oïdium. *Vide* Plate IV. fig. 3.

Leptothrix.—I have nothing original to offer under this head, except to notice that some of the filaments produced from the union and growth of the nuclear form of torula bear the closest resemblance to leptothrix. Example will be seen by referring to Plate II. fig. 14.

Once more I think it proper to state that in making experiments with fungi, care has been taken in germinating them in different fluids to compare together the changes going on in these fluids *with* and *without* the artificial addition of fungus elements, so that no error might arise in regard to the source of the latter, and all instances in which the chain of evidence as regards developmental stages could not be made good have been rejected. It is the more necessary to mention this because I have given less details than the botanist, who regards the matter from a purely *structural point of view*, probably expects. Enough, however, has been adduced to meet the demand of the practical physician, but, if necessary, additional description shall be forthcoming, the present essay being a summary only.

Summary of the relations of the Entophytes:

A. Under the head of torula, we find—

1. An appearance like torula may be seen in tinea tonsurans.
2. Aspergillus may result from the growth of torula (Lowe).
3. The aerial spores of penicillium develope into torula.
4. Trichophyton sporuloides may resemble torula (Walther).

5. Torula may grow and produce leptomitus at its base and oïdium at the terminal points of the mycelium.
6. Cholera bodies are in part torula (Herapath).

B. Under head of sarcina—

7. Sarcina may apparently develope from the spores of penicillium.
8. Puccinia is one form of fructification—in fact a sporangium.
9. According to Mr. Berkeley, sarcina, aspergillus, and penicillium are derivable from the same source.
10. A quaternate arrangement of spores may be produced by the growth of the trichophyton.

C. Under head of oïdium albicans—

11. The growth of torula may produce the fructification of oïdium.
12. Chionyphe Carteri and oïdium are similar (Dr. Bidie).

D. Under head of mucor, penicillium, and aspergillus—

13. A study of the changes which ensue in the development of aspergillus leads one to believe that the three above named are different stages of one and the same fungus.
14. Torula may be produced from the spores of either aspergillus or penicillium (Lowe).
15. Chionyphe Carteri and the mucors have a common origin (Berkeley).
16. Torula may assume the form of mucor according to Kützing.

E. Under head of leptomitus—

17. Torula and leptomitus are stages of one another (Mitscherlich and Lowe).
18. Bennett's fungus, the vaginal and uterine parasite, &c., bear the closest resemblance to leptomitus (Berg and others).

In a summary formerly given of the relations of the *epiphytic* diseases themselves, the interchanges and similarities of their fungi were omitted, so that they might be appended here, after the *Entophytes* had been discussed.

A. With regard to achorion Schönleinii,
   1. Aspergillus results from the germination of achorion (Lowe), and,
   2. Müller, Retzius, Remak, Lebert, Robin, and others ally it to oïdium.
   3. Raciborski has noticed trichophyton sporuloides assume the characters of achorion.
   4. The sporules of trichophyton tonsurans may become large and oval.
   5. Torula and achorion are identical according to some—*ex.* Mr. Hogg.

B. Trichophyton tonsurans,
   1. May develope into aspergillus (my own germination).
   2. May assume characters of achorion (Mr. H. Thompson).
   3. May take on the quaternate form.

C. Trichophyton ulcerum resembles T. tonsurans, and

D. Trichophyton sporuloides, torula (Walther).

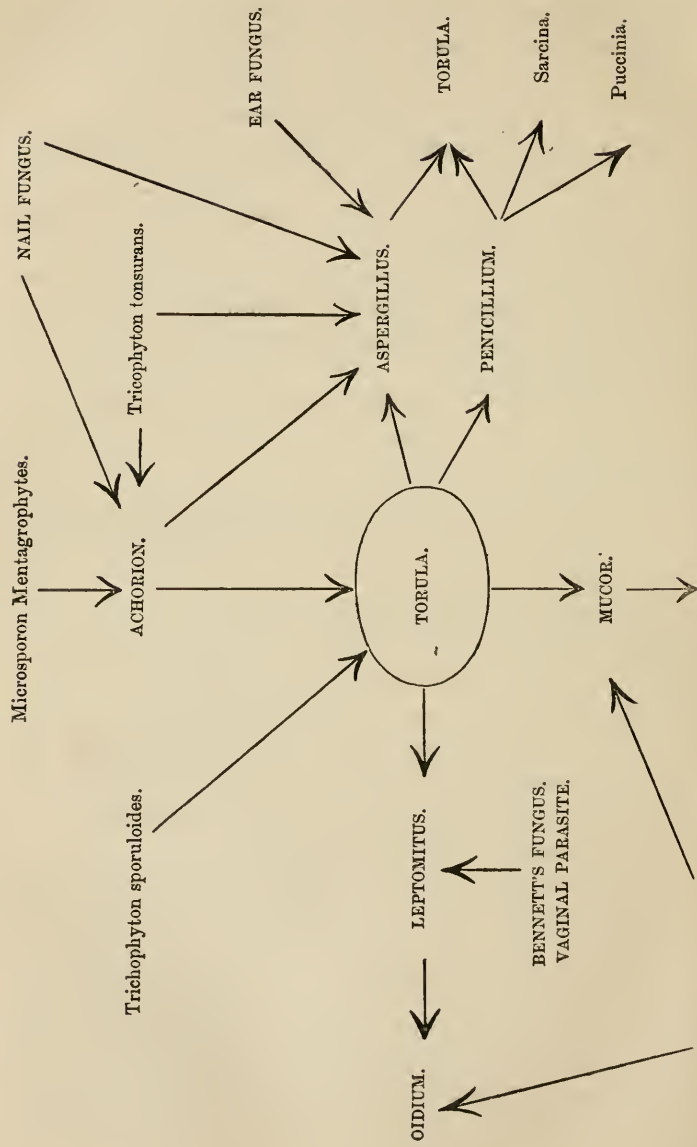
E. The fungus of tinea circinata (trichophyton) may exhibit, in its mycelial form, a terminal sporangium or the spores become oval.

F. Microsporon mentagrophytes may assume the aspect of achorion. *Vide* Plate II. fig. 4.

G. The nail fungus may resemble achorion or aspergillus (Virchow).

H. The ear fungus, oïdium (Pacini), aspergillus (Robin), mucor (Küchenmeister).

The following diagram will perhaps be of some little assistance in the investigation and appreciation of the relations of fungi. It will be noticed that torula is the centre around which all other forms of parasitic growth group themselves.


EAR FUNGUS.
TORULA.
Sarcina.
Puccinia.
NAIL FUNGUS.
Tricophyton tonsurans.
ASPERGILLUS.
PENICILLIUM.
Microsporon Mentagrophytes.
ACHORION.
TORULA.
MUCOR.
Chionyphe Carteri.
Trichophyton sporuloides.
LEPTOMITUS.
BENNETT'S FUNGUS.
VAGINAL PARASITE.
OIDIUM.
EAR FUNGUS.

Thus I have attempted to put together, in an easy and complete form, the evidence derived from clinical and experimental observation. Can all the facts brought forward be explained except upon the supposition of the identity of fungi? I think not; but at the same time am most desirous not to ride any hobby, and would by no means group together any but the mucedinous fungi. There are some who think that the various phenomena may be easily interpreted by supposing the existence of several kinds of fungi in one and the same skin disease. But the effect of germination, and the occurrence of transitional forms set the question at rest. Dr. Hillier, in his pamphlet, writes (in reference to evidence adduced):—"Now all these facts do not, to my mind, prove the identity of fungi, but merely corroborate what Dr. Fox himself says as to the distinction between the eruptive and the parasitic elements in these diseases; they seem to show that a soil which is favourable to the growth of one fungus may encourage the growth of another distinct fungus, and also that the eruptions produced by different fungi may resemble each other." Mr. Berkeley's view of the matter, which is the opposite of Dr. Hillier's, will be found under the head of sarcina, and derives confirmation from the considerations I have adduced.

We have still to unravel many mysteries in regard to vegetable parasites; among others—

1. The limit of variation as regards form in any and the same species.

2. The primitive or original type.

We are on the road towards finding the former, and, guided by the facts mentioned, we are compelled to conclude that the variability of any fungus is extreme, much more than we are wont to believe, and no confidence can be placed in any test but that afforded by the character of the *perfect* fructification. I say *perfect*, because it is pretty certain that this should possess *free aerial cells*, and that so-called sporangia are incomplete evolutions of fructification. This branch of the subject, of the utmost importance to the medical man, of which we know little, and which demands investigation

both clinically and experimentally, is that which comprehends the several causes of variation in the different instances of the tineæ and fungi.

In regard to the second point alluded to, much uncertainty exists. The diagram given just now exhibits the fungi found upon and in the human body, as (*quoad* their source) "focusing" themselves in torula or its ally penicillium; in fact, the ordinary "mould."

I must anticipate in this place one excess which is likely to be committed. It may be said, if the fungi be identical, why not do away with the various distinctive names of those diseases in which fungi occur, and also those of the fungi themselves? This would be, to say the least, injudicious; differences in the fungi and physical aspect of the tineæ result from differences in the character of concomitants, such as soil, &c., and the peculiar "appellations" are best retained as guides to treatment.

In concluding this part of the subject, I would be understood as standing by the propositions which were advanced by me in the *Lancet*, September, 1859:—

1. Tinea, the generic term for parasitic affections of the surface, which is a disease of the hairs and epithelium, and not an eruptive one, must be regarded as essentially and primarily caused by the growth of a fungus, since the characteristic effects (upon the hairs) are never produced without such growth.

2. There exists but one parasite, common alike to the several so-called distinct kinds of tinea.

3. The variations are mostly in the external characters, in the *superadded* rather than the *essential* conditions, for the parasitic growth varies but little, and that in degree, not in kind.

4. The superadded concomitant states, by their variation, fully account for the observed differences in physical and minute appearances.

5. A certain soil is requisite for the growth of the tinea vegetation, and that furnished by the non-specific eruptive crasis is the necessary one.

6. The treatment consists of general measures to correct the soil, and local measures to destroy the parasite.

I added, "It is not improbable that future experience will show that parasitic growths of the mucous membrane are derived from the same source as those of the surface, the difference of habitat, &c. fully accounting for the varied results."

CHAPTER XIII.

The Treatment.

Firstly. If, as the foregoing remarks tend to show, but one tinea vegetation exists, if apparent varieties are due to *superadded* (collateral), rather than *essential* conditions of disease, the treatment must be the same *in kind* in all cases, modified, of course, in degree to suit each particular instance; and this is found to be true in practice.

Secondly. That which is usually regarded as parasitic disease is a complex matter, composed of A, a diathesis or soil; B, the growing parasite; C, the lesions (disease of hairs and epithelium).

Thirdly. It is important to discriminate between the actual disease and the effects produced by it. *The thing to be prevented is alopecia.* If there be a parasite present, all efforts must be directed towards its destruction, and the restoration of the hair will then speedily follow; it is of little avail that we encourage the growth of the hair until the primary cause of mischief be removed.

Tinea is a disease which requires much steady perseverance and watching in its conduction to a successful and *speedy* issue; it demands at the outset a clear idea of the end to be attained, and the settlement of a definite plan of remedial action. Much harm and unnecessary delay is occasioned by the employment of half measures, the result of undetermined conduct, and it not uncommonly happens that a certain mode of treatment is pursued for awhile till the practitioner or the patient becomes impatient; or it may be the experience of the medical man is not ample enough to

correct his doubt and give him confidence, when a change is made, and the cure delayed in consequence. In the treatment of tinea there is the greatest need of *perseverance*, and that *in a simple and definite form.* A multiplicity of remedies betrays a weakness of curative power.

Our aim should be, as a rule, after having ascertained the extent of mischief by microscopic examination,

1. To alter the soil.
2. To kill the fungus, and prevent further mischief.
3. To promote the re-growth of the hair.

The therapeutical measures should be, then, general and local. The combination is in some cases unnecessary; for instance, arsenic given internally will assuredly effect a cure at times, and, per contra, the cases are very numerous in which the employment of local means alone suffices. In the one case, the soil being altered the plant dies; in the other, the fungus is killed directly, and this cause of irritation being removed, the eruption, if present and *consecutive*, vanishes. Neither of these methods, however, single-handed, can effect a cure so speedily as the two combined. Where the disease is superficial and *recent*, local applications are perfectly effective. I have witnessed a large proportion of such cases of all varieties (except favus), in which a single application of a spirituous solution of bichloride of mercury has completely got rid of all mischief. It is in long-standing cases, or what is practically the same, where the fungus has obtained a deep hold upon the follicle, that general treatment is of great benefit; in tinea tonsurans the strongest parasiticides, with attempted epilation, will, in severe cases, apparently fail, until by the exhibition of internal remedies the soil has been altered. Epilation, *if it be perfect* (with the subsequent application of parasiticides), will succeed; but in tinea tonsurans it is imperfect, and some of the fungus is sure to be left behind. *Cleanliness*, both local and general, is a *sinè quâ non.*

1. To alter the soil.

In favus and tinea tonsurans the scrofulous and tuberculous diatheses are present; in such, then, ordinary prin-

ciples must guide us. Cod-liver oil, iron, and arsenic are the remedies that require notice. With regard to the exhibition of arsenic more particularly, a few words are required. The use of this drug is *perfectly safe* if given after meals, most easily managed, and so far as can be ascertained, never produces any permanent ill effects if given in moderation. There can be no doubt that indirectly its exhibition is attended, in some cases, with bad results. No observant man can see much of skin disease without coming to the conclusion that the system of making rapid cures of old-standing eruptions, which prevails at the present day, is fraught with danger. I have heard it remarked by those who have had opportunity of rightly estimating the matter, that it not unfrequently happens that patients do ill after such cures; this, I believe is a just conclusion.

It would be well if medical men would follow up more closely the history of those in whom long standing eruptions have been quickly cured by "specifics." Now, arsenic is regarded as a "specific" for ringworm, and hence, under certain circumstances, might be open to the charge I have hinted at; but lest I appear to contradict myself, let me add, that it is rather the *excessive use* which is to be guarded against. It should be used in moderate doses for a few weeks, then omitted for awhile, and always, if the constitutional effects of its exhibition show themselves. Though a strong advocate for the employment of arsenic in moderation, I do verily believe, from what I have seen, that its *long-continued and free use* is productive of harm, and ill effects follow its disuse sooner or later. A mild course, if disease be obstinate, if there be evidence of constitutional scaly disease or the like, and in conjunction with iron when anæmia is present, is desirable as the rule. When symptoms of gastric disturbance are marked, when the appetite is bad, the tongue foul, the skin harsh and dry, the urine loaded, and the bowels irregular, aperients and a mild course of alkali and bitter are very serviceable.

Tinea circinata mostly requires literally no general treatment. Now and again, however, in schools especially, this

variety of ringworm is positively worse than obstinate, travelling over the general surface, and no sooner has one spot faded off than another appears, and this in spite of the use of sulphur baths, bichloride of mercury lotion, and such like. A course of arsenic in combination with iron, if the latter be indicated, may do good, or it may signally fail, matters get worse instead of better; in such a case the constitutional effects of the arsenic must be produced, or recourse had to potash and sarsaparilla in addition. If these do little good, cod-liver oil, iodide of potassium, or a mercurial course will be of avail. The family history must be very minutely and carefully interrogated.

Tinea Sycosis.—The indulgence in fermented liquors is not by any means an unusual failing in those affected by sycosis, and must be interdicted in a decided manner. Dyspepsia of an irritable kind may be present, in some instances the consequence of the free indulgence in stimulants. As a rule, the general treatment should be somewhat antiphlogistic. Living should be abstemious, light and easily digested food should be taken, all substances "heating" in their nature be avoided, such as wines, coffee, and spirits; animal food should be taken in moderate amount. The bowels especially should be regulated, and, if necessary, saline aperients used pretty freely. When the stomach is at fault, as shown by flushing after meals (with increased heat of the part attacked by sycosis), pain at epigastrium, acidity, &c., and when in addition the urine is scanty and high coloured, the free use of alkalies is of very great benefit, for instance, bicarbonate of potash, carbonate of magnesia, nitrate of potash, with some aromatic and bitter infusion before meals. In some cases of atonic dyspepsia with a clean tongue, the mineral acids are beneficial. After a time sycosis assumes an indolent and chronic aspect; even here, as a preparatory measure, the condition of the various secretions must be attended to, and rectified if at fault before any general remedies are prescribed. If there be any reason to suspect the existence of a *syphilitic taint*, a course of bichloride or iodide of mercury and sarsaparilla must be

adopted; this plan of treatment answers well in some of the *non-syphilitic* cases where the pustules are indurated to a marked extent, and the disease rather *one of disfigurement than of pain.* Other examples are marked by co-existent anæmia, loss of flesh, and so on—not that these are necessary components of sycosis—when the preparations of iron with cod-liver oil are demanded. Arsenic is regarded by many as a certain specific for this variety of tinea. Where the disease is obstinate, the patient lymphatic, and there exists any reason to suspect the existence of a tendency to scaly skin eruptions, either in the patient's habit or the family history, the remedy will materially assist the effect of local applications. Arsenic oftentimes obtains more credit than is its due in the cure of sycosis, and the quiescent state of disease is regarded as a success, the fact being that exacerbations take place in spring and autumn, and what may be termed the natural temporary cure is placed to the credit of the exhibition of arsenic. The cure is not complete unless the seasonal alternations peculiar to sycosis are negatived. The preparations of the drug to be used depend pretty much upon the fancy of the practitioner; in one instance Fowler's solution, in another the liq. arsen. chlorid., or the liq. potas. arsenit. is selected. Change of air, with or without a course of saline waters, may be advisable. A vegetable diet is mostly called for, provided the digestive organs are in a healthy state. Cod-liver oil, there can be no doubt, does immense good in some cases of sycosis.

Tinea Decalvans.—The general treatment is very simple, and consists in the correction of the secretions and the exhibition of tonics, according to circumstances. Arsenic is much praised by some, especially Mr. Hunt, for its power over the loss of hair. In obstinate cases it certainly does good, and helps to restore the scalp to its normal state through its action upon the system at large, and there should be no hesitation in exhibiting it; if there be any other forms of tinea present, the local treatment is decidedly the most important. As in other varieties, the collateral conditions are easily appreciated, and iron and cod-liver oil are called for

sometimes. The point requiring special attention is the existence of dyspepsia, in many cases amenable to the use of alkalies and vegetable bitters. I have, however, seen more than one case in which this derangement of the system was most intractable, and in which all remedies appeared to fail on account of the large amount and degree of acidity present. This must be treated upon ordinary principles.

Tinea Versicolor, as a rule, requires positively no general treatment. It is affirmed that a recurrence is likely to take place if an arsenical course be omitted; but, so far as I have seen, local measures are most speedy and effective in promoting the cure of chloasma, simply for the reason that the fungus has no very deep hold upon the surface, and is therefore easily reached; however, in obstinate cases the use of arsenic is advisable.

The treatment (as regards general measures) of tinea pilaris is that of the skin disease which it complicates; and in tinea tarsi the scrofulous diathesis is mostly marked, and there is no other case in which arsenic does sometimes more good.

Of the general treatment of plica polonica and the madura foot nothing is known in England; the former is said to yield to the internal and external exhibition of lycopodium clavatum (club-moss).

The Local Treatment.

This may be directed towards the destruction of the parasite or to promote the re-growth of the hair. There are certain general remarks applicable alike to all varieties of tinea, and various preliminaries which are necessary to be adopted, that require a few words of comment.

1. *Venesection.*—This has been recommended in cases which are marked by much activity either of the general or local circulation. In sycosis, at times the chin is hot, smarting, tender, and swollen, and some benefit may be derived from abstraction of blood; a few leeches applied at or near the circumference of the disease will often answer the purpose of general bleeding. In the majority of cases, however,

it is right to add, salines and soothing fomentations suffice to bring about the desired result.

2. *The use of Setons, Issues, and such like.*—In some old standing cases, more especially of favus and tinea tonsurans, these remedial agencies are looked upon in their application as salutary, more particularly as safeguards. The late Dr. Graves was very emphatic in recommending their use. He says: "When the disease is of long standing, always insert an issue into the arm before you attempt its cure. I have seen water on the brain, and other fatal consequences, from the neglect of this precaution." Physicians at the present day do not countenance this proposition; and it is no means unlikely that the belief which it expresses arises from the fact that under the term porrigo, or tinea capitis, many instances of impetiginous disease have been ranked, and the evil consequences ensuing upon the rapid cure of these latter attributed to the disappearance of true tinea. Most decidedly there is no reason to *anticipate* (by the *universal practice* of inserting setons and issues) the occurrence of mischief in the brain or elsewhere; the progress of any case, when undergoing cure, must be our guide in the matter.

3. *Cleanliness.*—This is absolutely essential, and too much stress cannot be laid upon its adoption. The only case in which any rough usage, such as thorough washing, is inadvisable, is that of tinea circinata attacking the surface of delicate children, and spreading with considerable irritation. The surface of the skin, as a whole, must be brought into a healthy state by baths and the like; and all obstacles, such as scabs, which not only prevent our applications obtaining free access to the fungus, but also from containing sporules, favour the spread of the disease, must be removed. A clean surface must be prepared by poulticing, greasing, and subsequent washing with soap and water. No secretion must be allowed to dry and remain on the scalp. It is advisable, too, to keep some oily matter applied to the scalp; this keeps it moist, cool, and certainly in some measure arrests the dissemination of the parasitic germs, and tends to exclude air. Cod-liver oil, topically applied, probably acts in this way

(mechanically) to a very great extent. Glycerine is of use also in like manner.

4. *Epilation.*—The sporules are most abundant in and around the roots of the hair; consequently, any method which, like epilation, causes the removal of the latter in its entirety, must of necessity help in greatest degree the progress of convalescence, and facilitate the action of parasiticides. But this process is by no means an easy matter in some instances: for example, in tinea tonsurans, where the hairs are dry and brittle, and the moment epilation is attempted break away, leaving more or less of their follicular part behind. The following proposition holds good always: *Any plan of treatment which makes the removal of the entire hairs of first importance is decidedly that best calculated to cure tinea.* Various plans have been proposed from time to time with the view of effecting this end. The oldest custom was to apply certain plasters of a firm consistence to the scalp, so as to remove the hairs which "stuck" to them when torn off; this is now in disuse, except in some parts of France. Certain depilatories have been recommended, such as carbonate of potash or soda, or lime. Blistering will produce pretty much the same effect.

The easiest and best plan is to remove the hairs by means of a pair of forceps. Some authorities are very precise in describing a particular kind; a pair of common dressing forceps, nicely made, answers all purposes; the small ones sometimes made tire the hand very much. If you wish to succeed in the operation, do it yourself, and take plenty of time over its execution; drag out carefully two or three hairs at a time, pulling in the direction of their shafts, and having cleared a space about the size of an inch or so, apply some strong parasiticide. It is of great importance to remove all *black "stubs"* seen in diseased patches, for these are perfect storehouses of sporules. If the operation is painful, apply a little chloroform from time to time, and the operation becomes in some instances painless. After epilation, keep the part well greased, so as to avoid fresh inoculation. If the disease is recent, blistering with a strong

solution of bichloride of mercury will help subsequent epilation, and with it speedily do good service. If the disease be recent, and one of the slighter forms of tinea, the local application of parasiticides alone suffices; not so, however, if it be severe, deep, and of *long standing*, and this leads me necessarily to remark that at the outset a careful microscopical examination must be made to ascertain the extent of mischief. If the sporules are detected in and around the roots of the hairs it is much best to depilate; but, as before observed, in tinea tonsurans removal of the follicular part of the hairs may be difficult of accomplishment, not always; it should, however, be attempted as far as possible. The remaining hairs may be got rid of by using a strong solution of carbonate of soda, and subsequent shaving; the "dark stubs" seen in this variety of tinea must be got rid of by the use of the forceps. It is sometimes difficult to distinguish between healthy and diseased hairs; depilation then becomes painful; but in early stages it is best to remove *from a diseased patch* all hairs, be they diseased or apparently sound; but later in the disease, we may be content with getting rid of any that are dry, and twisted in their emergence from the follicle. In the former case, *where the mischief is on the increase*, it is probable that the healthy, surrounded by diseased hairs, will be sooner or later attacked by the fungus and require removal. The sensibility of the patient must be allowed to dictate the amount of space over which depilation may be carried at one sitting; generally we are enabled to clear a space of from one and a half to two inches square, with some patients more, especially if the outward application of chloroform is had recourse to.

5. *Parasiticides.*—These have been multiplied almost without number, and various authorities have selected certain chemicals as so many *sinè quâ nons* of treatment. Parasiticides of course act most efficiently after depilation has been practised, and should be sufficiently active to destroy, and as much as possible possess a penetrating power, so to speak, whereby they may easily reach the fungus elements, and these objects will be best answered by using a strong spi-

rituous solution, or by friction with ointments. When depilation appears unnecessary, the tissues may be prepared by the use of liq. potassæ. In *one sense* it is good to make a hobby of the use of one or two particular remedies; the indiscriminate selection of several parasiticides is much less effective than the persevering employment of one only. *Cæteris paribus*, I much prefer the bichloride of mercury to any other, and almost invariably use it in the proportion of ℈ij to ʒiij or ℥ss of spirit in the severer, and about half the strength in the milder cases. The stronger solution requires some little care in its management, and will generally be found to act thoroughly well if *brushed lightly* over the affected part once or twice, when a tingling or feeling of heat is felt, the surface shortly blisters, and a scabbing is left in the course of a day or two, which may be removed, the part cleansed by poulticing and greasing, and the remedy reapplied if necessary. I have used this solution extensively, and never saw any symptom of salivation follow its employment. Sometimes the fungus appears to be out of the reach of this fluid, especially (as in severe tinea tonsurans) where the hairs cannot be removed; then the following ointment may be rubbed in, night and morning, until it blisters the area of the patch of disease, composed of hydrarg. bichlor. gr. x vel xxv, ad unguent. ʒi. Recently I have tried the carbolic acid, which appears to act uncommonly well; it seems to penetrate so very decidedly into the structures. The application causes some considerable pain, and the acid must be diluted according to circumstances; but it is better to make one thorough application at the onset than several minor ones during the progress of the disease. Carbolic acid must be lightly applied with a camel-hair pencil. The minor parasiticides, adapted for tinea circinata, slight tinea tonsurans, are tincture of iodine, nitrate of silver, iodide of sulphur, and such like.

6. *Shaving.*—It is advisable to keep the hair of diseased patches closely shaved unless epilation be adopted; this is an important item in the treatment of tinea tonsurans. In sycosis the razor must be put aside, and the hairs cut with a

pair of sharp scissors. In favus, after depilation ceases to be absolutely necessary, it is advisable to keep the head shaved, because under such circumstances the diseased spots can be so easily watched or detected, and any deviation from the healthy condition at once recognised and intercepted, be it erythema, deviations in the direction of the hairs, or other change. Throughout the whole treatment of tinea, when active, a clear view of the surface of the scalp must be obtained, either by the aid of epilation, or shaving, or sharp scissors.

7. *The use of soothing agencies.*—This is an important branch of therapeutics. When strong parasiticides are applied, a good deal of swelling, tenderness, redness, and heat results; now this interferes with our keeping up the action of those drugs which tend to destroy the parasite, hence it is necessary to arrest quickly the spread of these inflammatory conditions, in order that the re-application of parasiticides may be possible and proper. Now to this end emollients may be had recourse to; gruel, decoction of poppy-heads, lead and opium lotion, decoction of dulcamara, bran tea, solution of carbonate of soda, simple lard, and glycerine are especially useful. Oleaginous substances used subsequently to or in conjunction with poulticing are on many grounds preferable. The scalp, or other part to which strong remedies have been applied, should be dressed with an ointment composed of lard, tincture of opium, and liq. plumbi, or simple zinc ointment. If the surface be blistered, the scabs when dry are to be removed by poultices, and the head subsequently greased or anointed with the lin. aq. calcis, which is one of the best applications in all cases of scalp disease.

It will be advisable, after these general remarks, to sum up under separate heads the treatment applicable to each variety of tinea, appending certain formulæ which may be used as circumstances may demand.

First as regards favus. Depilation is a *sinè quâ non;* this should be followed by the immediate application of parasiticides—the bichloride of mercury in the form given before

is the best. Carbolic acid appears to answer equally well. The application must be made to penetrate deeply into the follicle, and sufficiently strong to blister the surface severely; in this way, in all probability, the number of applications is lessened in the general total as compared with cases in which milder means are used, while there is very little exaggeration of pain. As soon as the immediate effect has subsided, a clean surface must be obtained and the local remedies reapplied, or some milder preparation used. The following have been recommended: Sulphurous acid, either undiluted or mixed with from two to four or six parts of water, to be kept applied by means of linen cloths covered with oil silk, and frequently renewed; tar ointment constantly painted over the disease; iodide of sulphur ointment, gr. x—gr. xv to ℥j of cerate, is one of the best local remedies when favus is undergoing cure, and where the scalp is very irritable; nitrate of mercury; benzole; cod-liver oil; solution of carbonate of soda, ʒij to ʒiv ad lbj of water; tincture of iodine; iodide of mercury; ung. hyd. nitr.; sulphuret of potassium; chloride of copper; sulphate of copper, gr. x ad ℥j of lard; nitrate of silver; alum; oxide of manganese; cocculus indicus, ʒi ad ℥j ungt.; hellebore; cantharides; sulphate of iron; acetic acid; naphtha; oil of cade; decoction of poke-root (phytolacca decandra), Dr. Carey. Mr. Startin recommends an ointment composed of sulphur, ammoniated mercury, Æthiops mineral, creosote, lard and oil; croton oil; sulphur; cassia alata, Bahia or Brazilian powder, the fresh leaves are mixed with an equal part of lime juice, and this is made up into a paste with an equal amount of cerate, and applied three or four times. It is a remedy of much repute in India, and attention was directed to its use in a recent number of *Edin. Med. Journal*, by Mr. Little of Singapore. I have invariably failed to obtain it in London. As observed before, I have little faith in the use of the many, only in that of the few remedies, provided these be employed with unswerving perseverance. Epilation, bichloride of mercury, carbolic acid, iodide of sulphur ointment, and lin. aq. calcis are those from

which I have seen most marked and decisive results follow, and these are sufficient to meet the most obstinate cases.

Favus, of all others, is a good example of the power possessed by the physician over disease and drugs; if the latter be handled aright, a determination to outroot and destroy every particle of fungus kept in due bounds by microscopical examination, and a regard to the healthy action of the tissues of the scalp, must ultimately succeed, and the degree of success depends upon the practitioner himself. No case is so bad as to be hopeless of cure.

Tinea tonsurans.—Depilation is here often impracticable; not always, however, and the attempt should be made to get rid of the hairs by means of the forceps; and it is a great desideratum, as tending to prevent the spread of disease, to epilate the hairs situated in the healthy circumference immediately adjoining the circular patch of disease. If the shafts of the hairs break off when they are caught between the forceps, the better plan is to shave the diseased patch at once, taking care to use plenty of yellow soap, and to rub it freely into the scalp, for not unusually, after this proceeding, the mere act of shaving drags out many of the diseased and loosened hairs; besides, the dissemination of the germs of the fungus is counteracted to some extent, and the applications subsequently made appear to act so very efficiently. *All black stubs that make their appearance during any part of the course of the disease must be removed by the forceps.* Having obtained a clean surface, the bichloride solution should be applied, and the subsequent irritation allowed to subside. Now, supposing the hairs grow up from the follicle in a straight manner, and are not dry, shrivelled, and twisted, the use of the mild parasiticides only is required, such as sulphurous acid more or less diluted, tincture of iodine, nitrate of silver, and iodide of sulphur. Indeed, these are often efficacious if the disease be of *recent* origin when treatment is first sought; on the other hand, if of long standing, it is desirable to keep up the action of the bichloride for some time, until we are satisfied that its influence extends to the bottom of the follicle, and for this

purpose the ointment is best adapted of the strength of gr. x—xv to ℥j of cerate, and rubbed in night or morning, or both, according as the patient can bear it. If there be several distinct centres of disease, it is a safe plan to keep the whole head shaved and washed night and morning with a sulphurous acid lotion (one part to four or six of water), and in the interim to apply, by means of a piece of sponge, the linim. aq. calcis, taking care to wash the head well before every fresh application. For my own part I prefer a solution of bichloride of mercury diluted according to circumstances, or some preparation of sulphur, to anything else. When the hair is kept closely cropped, the disease is much more manageable, and the growth of the hair in the diseased situations can be compared with that of the adjoining healthy parts, and any rekindling of mischief *at once* detected, which would not be the case under opposite circumstances. The various local remedies which have been lauded from time to time as possessing curative powers are pretty much the same as those mentioned under the head of favus. In addition to these may be mentioned: Tartar emetic—chlorine gas—infusion of savin (℥ij ad ℥iij)—infusion of tobacco—black pepper, ℥iv to lbj lard—iodide of lead—bromide of potassium—liq. sod. chlor.—sulphuric acid and veratrum album.

Tinea Sycosis.—This variety of tinea is to my mind the most unsatisfactory, and frequently the most difficult of cure, not on account of its intrinsic properties, for the fungus elements are by no means in the majority of cases in so great an abundance as in the other forms of tinea, yet enough to set up and keep going marked irritation, but inasmuch as patients mostly cannot be induced to submit to depilation, and the knowledge that this plan of treatment is the most effectual, makes it most annoying to be thwarted when the means of relief are so near at hand and yet unavailable. The local application of chloroform by means of a piece of sponge, cotton wool, or a camel-hair pencil, continued sufficiently long to diminish cutaneous sensibility, will lessen, now and then, the pain arising from

depilation. As before observed, the razor must be avoided. If there be much local inflammation, soothing applications may be used at the outset, such, for example, as almond emulsion, bran water, hot fomentations, poulticing, and opiate fomentations. Some advise the free and repeated application of strong nitric acid, or some blistering fluid, but these do not penetrate sufficiently deep to do any positive good unless used *very freely;* besides, as Dr. Anderson observes, "they cause much pain, while they are not nearly so generally nor so rapidly effectual as the treatment by depilation." If we wish to destroy the fungus by parasiticides, the selection should be made from the alcoholic solution of bichloride of mercury, the compound sulphur ointment, which is often very efficacious, the iodide of sulphur, and the ammonio-chloride of mercury (℥j ad ℥iss) ointments. The friction used in the application of ointments certainly does seem to be instrumental in introducing remedies effectually into the follicles. Some of the hardest tubercles derive benefit from being punctured.

General remedies have been briefly referred to. Arsenic certainly appears to act wonderfully in some cases, in others a process of "slow poisoning" may be had recourse to without much benefit. Such failure should suggest the desirability of attending minutely to the condition of the various secretions. In sycosis we must oftentimes be content with the exhibition of medicines calculated to give tone to the system, relinquish all hope of depilation, and persevere in the use of solution of bichloride of mercury or the compound sulphur ointment. Some good may result from the use of the solution of carbonate of soda. The following have been recommended in addition to the above: Iodide of mercury ointment; ung. hyd. nit.; iodine; carbonate of potash; oxide of zinc; sulphuret of potassium; iodide of potassium; prussic acid, &c. Carbolic acid deserves trial; I have seen it act very efficiently.

Tinea Circinata.—In nine cases out of ten the local treatment is very clear and simple; the parasite has little hold upon the surface and is easily destroyed. Now and then the

fungus, taking the form chiefly of mycelial threads, literally *rambles* over large tracts of the skin, and no sooner is one spot well than another makes an appearance. The disease is rather erythematous than vesicular under these circumstances. I have examined a great many cases of the kind, and detected large pieces of mycelium extending a long way beyond the apparently healthy limit which circumscribes this or that patch, and in consequence of this property possessed by the filaments, the circular character is lost in the separate patches, and the disease assumes an irregular form. The blood state in these cases must be very favourable to parasitic growth, and the detachment of the loosened and diseased epidermis must materially tend to the spread of the tinea; *ergo*, and this is practically a truth of some importance, all oleaginous or unctuous applications do great good. Children are mostly affected by the special form now under consideration, and inasmuch as their skin is delicate, the application of topical remedies often increases the irritation present. It is best to abstain from the use of soap (unless there be special reasons to the contrary) and to wash the surface with gruel, white of egg, bran-tea, arrow-root, starch-water, and such like, and then to apply, two or three times a day, especially if there be any watery secretion (in other words, a quasi-eczematous condition) present, the benzoated oxide of zinc ointment. When the eruption becomes somewhat indolent and dry, mild parasiticides may be used; tincture of iodine, weak alcoholic solutions of bichloride of mercury (gr. ij—iij to the ℥j), or diluted sulphurous acid, are the best. At the same time general remedies are almost *essential*. These have been referred to. Arsenic is here of great service, iron is often demanded, and also cod-liver oil. Sometimes the obstinacy of the disease is overcome by the exhibition of alkalies or mercurials. The milder forms yield to simple vesication with the bichloride solution or the acet. cantharid., or the topical use of iodine, sulphur, and sulphurous acid.

Tinea Decalvans.—The local treatment is oftentimes very troublesome; much depends upon the result of microscopical

examination, the age of the patient, and the duration of the disease. If the fungus be detected, and furfuraceous desquamation or erythema be present, the bichloride solution should be used in sufficient strength to blister the patch diseased, and not only that, but also the part forming the immediate circumference. This line of treatment must be adopted when the disease is *recent* or the patient of *early age*. In older people the fungus seems to "exist" simply in consequence of the want of vitality in the scalp; free stimulation calls out the exercise of proper function, and the fungus dies out in consequence. The hairs are frequently remarkably dry, indeed there is a general lack of moisture about the scalp, and the use of the lin. aq. calcis or glycerine is of much value. Parasiticides should be applied particularly to the *increasing edge of disease*. It is remarkable that decided improvement follows ordinary blistering; it may be that the fungus is hereby destroyed, or in so far as it acts as a stimulant. The fact, however, is certain; hence it is a very good rule to blister all patches of tinea decalvans. The subsequent treatment is a matter of simple stimulation, and this will be referred to under its proper head. The use of nitric acid, iodide of sulphur, and liq. ammoniæ has been recommended.

Tinea Versicolor.—Some authorities appear to have experienced great difficulty in getting rid of this form of tinea. The plan which appears most successful, and which I have seen succeed in very extensive examples, is to soften up the cuticle with liq. potassæ, and then apply the sulphurous acid. A little pain is produced, but if the topical application be efficiently done once or twice the disease disappears. Of course, cleanliness is essential, and comprises frequent change of flannel, the use of soap and water, and the like. A weak solution of bichloride of mercury or sulphurous acid may be used night and morning for a few days after the use of the potash. Many prefer sulphate of zinc, sulphur, sulphuret of potassium, borax, or the mercurial ointments. The plan mentioned above, however, will be found most successful.

In tinea pilaris, the mild forms of parasiticides are called

for; and in tinea polonica, it would appear, personal cleanliness especially, the removal of the "mass," tepid fomentations, and subsequent application of parasiticides. The only other disease requiring notice is tinea tarsi, so far as local measures are concerned. If the disease is troublesome, epilation must be had recourse to: the ung. hyd., ammon. chlor., ung. hyd. nitr. oxyd., ung. hyd. nitr., ol. olivæ, vin. opii, zinci oxyd., hydrarg., iodid., and sulphur ointment have been recommended. I should prefer to follow up the removal of the hairs by the use of sulphur ointment; but we must be guided by the principle laid down in regard to the other tineæ. General treatment is demanded for the scrofulous state of system present.

I have so far indicated the commencement of the treatment of the several varieties of tinea; the further medication must be entirely regulated by—

1. The amount of secretion; its character.
2. The external evidences of spreading.
3. Microscopical examination.

If secretion be free (be it blastematous or purulent), and especially not the immediate result of the application of irritants, general remedies are demanded to alter the blood state present. Under this head, however, attention will be directed to one practical remark only. Take, for example, a case of tinea tonsurans: after it has been under treatment a little time, and powerful remedies have been used, the scalp gets into a quasi-inflammatory state, becoming œdematous, painful, puffy, and pouring out a good quantity of "effused" fluid. Now, this is not unfrequently looked upon as an aggravation of disease, and here we see the benefit derived from microscopical examination. In such a case the hair pulled from the follicle will be seen surrounded by the "blastema," more or less, and perhaps quite, free from fungus elements; under these circumstances soothing treatment is required. *The injudicious use of irritants protracts the cure.*

2. *The External Evidences of Spreading.*—I refer now to those of a minor character, which easily escape notice; for

example, thinning out of the hair, the hair coming out easily, its brittleness, its dryness, its twisted condition, the presence of erythema,—all of which should at once make us have recourse to that which is the only reliable test of progression.

3. *Microscopical Examination.*—Not only should the hairs of the affected spot, but also those of the adjoining part, be examined. Severe cases rarely steadily improve; the mischief will assuredly rekindle here and there insidiously, unless great care be taken, and this is most likely to happen during the stage of arrest, when we relax the severity of our measures, and are thrown off our guard by the favourable progress of the case. For instance, in a growing patch, or a diseased spot returning to a healthy state, all seems going on well, long fine hairs are springing up apparently in a healthy way, when suddenly an appearance of redness shows itself where before the surface was clean and natural, or the hairs of some one part grow ahead as it were of others, which look shrivelled, dry, pale, and crooked. Now, had microscopical examination been duly made, the fungus would have been found, or the re-forming hairs noticed to be atrophied and surrounded *in an irregular manner* by epithelial masses, &c. Very little fungus suffices to damage young hairs, and, luckily, simple means are effective (such as tincture of iodine) in arresting any fresh increment of mischief. Where the roots are much atrophied, the application of solutions of nitrate of silver and stimulation are beneficial. Now, it is advisable to keep parasiticides applied until all traces of fungus are lost. Epilation must not be altogether relinquished until the roots of the new hairs are, on minute examination, seen to be free from the parasite; the microscope must decide the point. So long as fungus elements are found in the roots of the hairs, so long must depilation be attempted, and strong parasiticides applied; where, however, the roots are much atrophied, caution is required in the use of the latter, and stimulation indicated. Now, in many instances, the shafts of the hairs are found to be diseased, whilst their roots are well formed, free from fungus, and infiltrated with pigment. In such examples, the chances are

that nature will overcome her antagonist, and carry the elements of destruction up out of the follicle as the hair grows; hence we see the importance, in one respect, of keeping the hair shaven. It is almost impossible to do more than indicate the general plan of treatment which may be advisable during the progress of tinea. He who would become an adept in the treatment of tinea, must first make himself thoroughly proficient in the details of microscopical examination. There are other minor points which sometimes are of assistance. As before noted, whenever there is much effusion around the follicular part of the hair, without the presence of fungus, a soothing plan of treatment is demanded. Whenever fenestrated membrane can be detected, we may rest assured that in that particular place the fungus has vanished; the same holds good when we notice the epithelial sheath intact; and it may be safely asserted that the presence of an ill-formed, or rather irregularly shaped root, with irregular masses of adherent epithelium along the shaft here and there, is almost diagnostic of the presence of some special local irritant, and if the action of parasiticides be excluded, of fungus elements. Again: the existence of little bulgings here and there in the shaft, which have a dark aspect, and appear to be due to aggregation of granules, or a splitting up of the fibres of the hair, is indicative of the presence of a parasite. *The epilation and the application of strong parasiticides should be practised by the medical man himself;* the patient should be seen *in severe cases* twice or thrice a week, *and microscopic examination should be frequent if a rapid cure be looked for.* When the parasite has been destroyed, it becomes necessary to correct the ill effects and to promote the re-growth of the hair. Irritation and inflammation of the scalp have been referred to in part; should, however, a chronic thickening of any part remain, after awhile the solution of nitrate of silver, in the proportion of ten or twenty grains to the ounce, will be found to hasten its removal. Atrophy and alopecia may be results in and of each and every variety of tinea, and the treatment of these conditions may be summed up in one word, viz., free stimulation, which

scarcely, if ever, fails. In old standing cases the scalp becomes very insensible to the action of local remedies, and here blistering is advisable. The panacea for all other instances is tincture of cantharides, ʒj to ℥j of spirit, to which may be added a little spirit of rosemary. Balsam of Peru, ʒij ad ℥ij ung. is recommended by some. Strong tincture of iodine acts very well.

Such is an outline of the treatment of the tineæ; the details can be mastered only through actual experience. *Perseverance, cleanliness, simplicity of treatment,* effectual but uncomplicated, a *thorough knowledge* of and a *constant careful search* for *microscopic evidence,* are *essential requisites* towards constituting a successful practitioner, and no case is entirely hopeless; the word *incurable* has no place in the history of tinea, as the following case, which, through the kindness of Dr. F. W. Mackenzie, was placed in my hands for treatment, will exemplify:—A poor idiotic girl, aged somewhere about thirty, an inmate of the Paddington Workhouse, had been the subject of tinea favosa for (it is stated by those who have had the care of her) some twenty-five years at the very least. Some affirm that the disease was congenital. She exhibits in a high degree the scrofulous conformation; the scars of former abscesses are visible, and her vital power is very low. From time to time, in her case, every conceivable plan of treatment, both general and local, has been adopted. Cod-liver oil, iron, arsenic in large and continued doses, full and free living, the lime preparations, &c., have been exhibited among other things; and sulphurous acid, sulphur, ammonia, chloride of mercury, iodine, and a very host of remedies applied locally. Indeed, I have been assured by those under whose care the case has been, that the patient has been poisoned, so to speak, or rather saturated, with a view to cure, by almost every remedy in the pharmacopœia, and repeatedly laughed at for undertaking the treatment. The girl was in University College Hospital some years ago, for several months and more, and discharged *in statu quo.* The disease, too, has travelled over the entire body; latterly the case has been looked upon as entirely hopeless of cure, and treated by the application simply of ointments and mild parasiticides.

Seven or eight months ago I undertook the treatment, and the "present condition" at that time will best be understood if I merely state that *after leaving the head without treatment for a little more than a week, the whole of the scalp became covered over with full formed and extensive favi*, and this condition I had sketched, *so that no disputation might subsequently detract from the truth and efficacy of the cure*. The hair had been considerably thinned out, and was lost entirely from the crown of the head. The patient was pale, pasty, thin; the teeth were all decayed or lost, and menorrhagia existed to a marked degree. Without going into tedious details, suffice it to say that the whole scalp was first of all poulticed and greased with bichloride ointment, to kill the vermin, the cups removed, and the whole hair cut close. Each day a certain portion was depilated and the stronger bichloride spirituous solution immediately applied, the head being well greased. Subsequently, every part over which epilation had been practised was shaved constantly, and the iodide of sulphur with sulphur ointment used. Depilation was over and over again had recourse to as long as any appearances of favi were visible, and when this was inadmissible on account of the extent of surface to be operated upon, shaving supplied its place. All erythematous patches were shaved, blistered, or "epilated." Any and every doubt was met and interpreted by the results of microscopic examination. So matters went on until the scalp appeared to be getting into a more healthy state, when tincture of iodine took the place of the more severe topical applications. It is proper to add that I saw the case every day for about the first month. By and bye, when the epithelial lining of the follicle was returning to a normal appearance, the bichloride solution was applied to *suspicious* places, and a mild parasiticide with an oleaginous or greasy substance to the scalp generally, and finally stimulation with the lin. aq. calcis. Two months ago the hair had grown vigorously and healthily over the scalp, except its crown, where, however, an improvement was taking place; all treatment was relinquished because the actual favus was cured. At the present time all is going

on well, no recurrence has taken place in any way or degree, and the patient remains well, with a good crop of hair; much to the astonishment of the old inmates of the ward, and those who were rather persecuting in their remarks when I first prognosticated a successful issue. No treatment whatever has been adopted for six months, with the exception of the use of the lin. aq. calcis, which corrects the inordinate production of epithelium.

The above case is one which at first sight appeared to show that the molecules of a higher may retrograde into those of a lower state of existence—a doctrine at variance with every lesson that Nature teaches us, but which has been cordially accepted by many. It was on this score urged to me that no cure could possibly take place because the *vitality* of the patient was so low that the fungus elements resulted from a transformation of the histological elements, and the character of this vitality, evidenced by the idiocy, could not be changed by any therapeutical plan. Such mystification, I confess, I do and did utterly reject; and feeling confident that fungus arose from out its own proper germs, and that it only needed perseverance in a determined attack upon the parasite, I attempted that which would be sure to be successful if properly aimed at—by destruction of the parasite the cure of the distressing malady. The case is one of the best examples of the power which the physician possesses over drugs—a power which very many fail to discover, on account of imperfection and deficiency, not in the remedies themselves, but on the part of the medical man; and an error creeping slowly ahead, and of vast moment, is that of trusting entirely to the *vis medicatrix naturæ*, and disregarding the immense help afforded by the proper use of drugs. Believing firmly in the almost unlimited efficacy of remedial agencies, I cannot but think that it would be to the great good of medicine if at any rate a few of the great ones of our day, instead of mystifying their generation with tempting hypotheses, would turn their valuable experience into a detector of those indications by which Nature and her antagonist, Disease, guide us to successful treatment.

FORMULÆ.

1. *Baths.*

Thirty gallons of water suffice for a bath, and to this quantity any of the following chemicals may be added as circumstances may demand.

Bichloride of mercury, two or three drachms dissolved with a little hydrochlorate of ammonia or dilute acid; *iodine,* two or three drachms dissolved with a little iodide of potassium; *sulphur,* one to four ounces; *borax,* in like amount; *sulphuret of potassium,* a pound; *carbonate of soda or potash,* in the proportion of from four or eight ounces.

The following, the Balneum sulphuris compositum of Mr. Startin, is very efficient:—

℞ Sulphuris præcipitati ..... ℥ij.
Sodæ hyposulphitis ... . ℥j.
Acidi sulphurici diluti ..... ℥ss.
Aquæ ..... Oj. Misce.
Modus. Oj. ad aquâ C xxx.

2. *Vesicating Parasiticides.*

(*a.*) ℞ Hydrarg. bichloridi ..... ℈ij.
Acidi hydrochloridi diluti ..... ℥ss.
Spirit. vini rectific. ..... ℥iv. Solve.

(*b.*) ℞ Hydrarg. bichloridi ..... gr. x—xx.
Ung. sambuci ..... ℥j. Misce.

(*c.*) ℞ Tinct. iodin. comp. ..... ℥j.
Iodinii .... gr. x.
Potassii iodidi ..... gr. xv. Solve.

(*d.*) ℞ Acidi carbolici,
vel
(*e.*) Acid carbolic
Glycerinæ—partes æquales.

(*f.*) ℞ Pulveris cantharidis ..... ℥ij.
Acidi pyro-acetici concentrati..... ℥viij.
Acidi tannici ..... ℥j.
Misce et macera per hebdomadam et cola. (Startin.)

3. *Milder Parasiticides.*

(*a.*) ℞ Potassii sulphureti ..... ℥iij.
Sapon. mollis ..... ℥j.
Aquæ calcis ..... ℥viij.
Spirit. vini rectif..... ℥ij. Misce. (Green.)

(*b.*) ℞ Sodæ hyposulphitis ..... ℥iij.
Acidi sulphurosi diluti ..... ℥ss.
Aquæ ..... ad Oj. Misce. (Startin.)

(*c.*) ℞ Hydrargyri bichloridi ..... gr. xij—xv.
Sp. vini rectif. ..... ℥iiij.
Ammon. hydrochlorat. ..... ʒss.
Aquæ rosæ .... ad ℥vj. Misce.

(*d.*) ℞ Olei olivæ
Aquæ calcis .... āā ℥iiss.
Hydrarg. bichloridi ..... gr. xij.
Glycerinæ..... ℥j. Misce.

(*e.*) ℞ Sulphuris præcipitati .. .. ℥ij.
Sp. camphoræ ..... ℈ss.
Glycerinæ..... ℥ss.
Hydrarg. bisulphureti..... ℈ss.
Pulveris amyli..... ℥ij.
Aquæ ..... ad Oj. Misce. (Startin.)

(*f.*) ℞ Acidi carbolici ..... ℥iss.
Glycerinæ..... ℥j.
Aquæ rosæ ..... ad ℥viij.
Misce, fiat lotio.

(*g.*) ℞ Ung. hydrarg. fort. ..... ℥iij.
Sulphuris ..... ℥ij.
Ung. flor. sambuci ..... ad ℥ij. Misce.

(*h.*) ℞ Sulphuris iodidi ..... gr. x—xxx.
Adipis ..... ℥j. Misce.
Adde si opus sit,
Sulphuris ..... ℥ij.

(*i.*) ℞ Ung. hydrarg. nitratis ..... ʒiv.
Sulphuris ..... ʒij.
Creosoti ..... ♏ x.
Adipis ..... ℥j. vel ℥ij.
Misce.

(*k.*) ℞ Hydrarg. ammon. chloridi ..... gr. vj.
Hyd. nitrico-oxydi levigati ..... gr. vj.
Adipis ..... ℥j. Misce.
(Startin.)

(*l.*) ℞ Sulphuris
Unguent. picis ..... āā ℥j.
Glycerinæ ..... ʒiv.
Ung. hydrarg. fort. ..... ʒiij. Misce.

(*m.*) ℞ Potassii bromidi ..... ℥j.
Adipis ..... ℥j. Misce.

(*n.*) ℞ Cupri carbonatis ..... ʒij.
Adipis ..... ℥j. Misce.
(Devergie.)

4. *Depilatories.*

℞ Calcis recentis ..... ʒij.
Sodæ sub-carbonatis ..... ʒiij.
Unguenti ..... ℥ij. Misce.
(Rayer.)

℞ Calcis ..... ℥iss.
Arsenici sulphureti ..... ʒj.
Amyli ..... ʒx. Misce.
(Plenck.)

5. *Soothing Applications.*

℞ Ung. zinci oxydi benz. ..... ℥ij.
Glycerinæ ..... ʒiij.
Sp. rosmarini ..... ♏xv. Misce.

℞ Tinct. opii
Liq. plumbi diacet. ..... āā ʒij—ʒiij.
Ung. sambuci ..... ℥ij. Misce.

6. *Special Stimulants of the Scalp.*

℞ Glycerinæ ..... ʒiij.
Linim. aquæ calcis ..... ℥iv.
Tinct. cantharid. ..... ʒiij. Misce.

℞ Aceti destill. ..... ℥iiiss
Tinct. cantharid. ..... ʒvj—ʒviij.
Aquæ rosæ ..... ℥iiiss.
Misce, ft. lotio.

7. *General Remedies.*

℞ Ferri ammon. citratis ..... gr. v.
Liquoris potassæ arsenitis ..... ♏v.
Syrupi limonis ..... ʒj.
Aquæ ..... ad ℥j.
Ft. haust., ter die post cibum sumend.

℞ Hydrarg. bichloridi ..... gr. $\frac{1}{16}$—$\frac{1}{8}$.
Liq. arsenici chloridi ..... ♏x.
Ætheris chlorici ..... ♏x.
Acidi hydrochlorici diluti ..... ♏vj.
Infusi calumbæ ..... ℥j.
Ft. haust., bis vel ter in die post cibum sumend.

℞ Hydrarg. protiodidi ..... gr. $\frac{1}{3}$.
Ferri sulphatis ..... gr. ij.
Ext. conii ..... gr. ij. Misce.
Ft. pil., nocte maneque sumend.

℞ Potassæ bicarbonatis ..... gr. xv.
Liq. potassæ arsenitis ..... ♏v.
Tinc. zigiberis ..... ʒss.
Aquæ carui ..... ad ℥j. Misce.
Ft. haust., ter die post cibum sumend.

℞ Acidi nitro-hydrochlorici diluti ... ♏xv.
Liq. arsenici chloridi ..... ♏x.
Tinct. gentianæ comp. ..... ʒj.
Aquæ ..... ad ℥j. Misce.
Ft. haust., ter die post cibum sumend.

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THE END.

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